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Oaks et al.

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(54) **MAGAZINE SPRING AND MAGAZINE ASSEMBLY**

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(22) Filed: **Feb. 22, 2023**

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(51) **Int. Cl.**
F41A 9/65 (2006.01)
F41A 9/71 (2006.01)

(52) **U.S. Cl.**
CPC .. ***F41A 9/65*** (2013.01); *F41A 9/71* (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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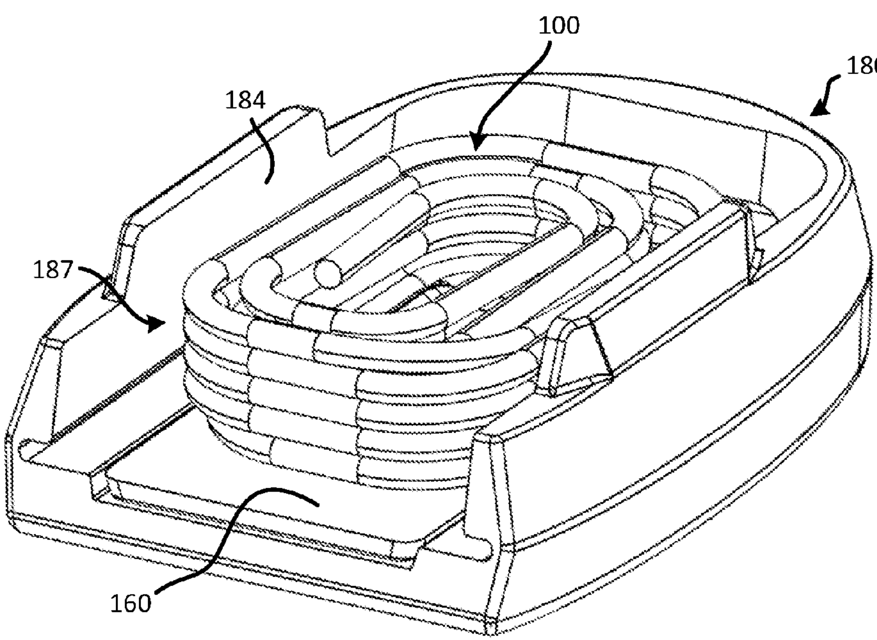
(57) **ABSTRACT**

A spring for a firearm magazine includes a top attachment leg, a plurality of upper coils connected to the top attachment leg, a plurality of intermediate coils below the upper coils, and a bottom attachment leg below the plurality of intermediate coils. The upper coils are sized and shaped to nest within the intermediate coils when the spring is fully compressed, reducing the solid height of the spring. In some embodiments, at least two complete upper coils and/or at least two complete lower coils nest within intermediate coils. In one example, at least some coils have a rectangular coil shape. The spring can be configured for use in a handgun magazine or a rifle magazine, for example. A handgun magazine and a magazine components kit including the spring are also disclosed.

19 Claims, 17 Drawing Sheets



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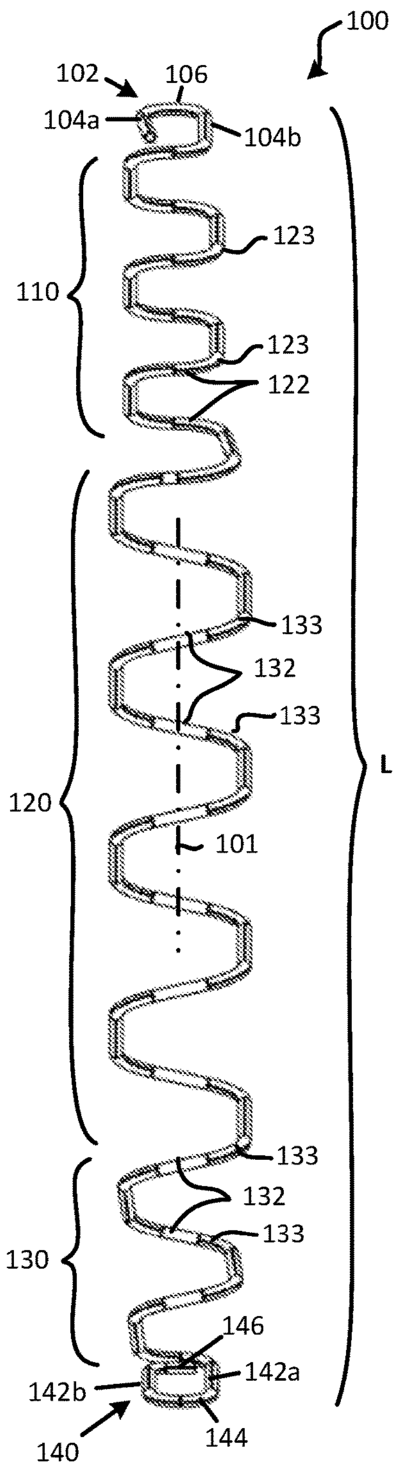


FIG. 1A

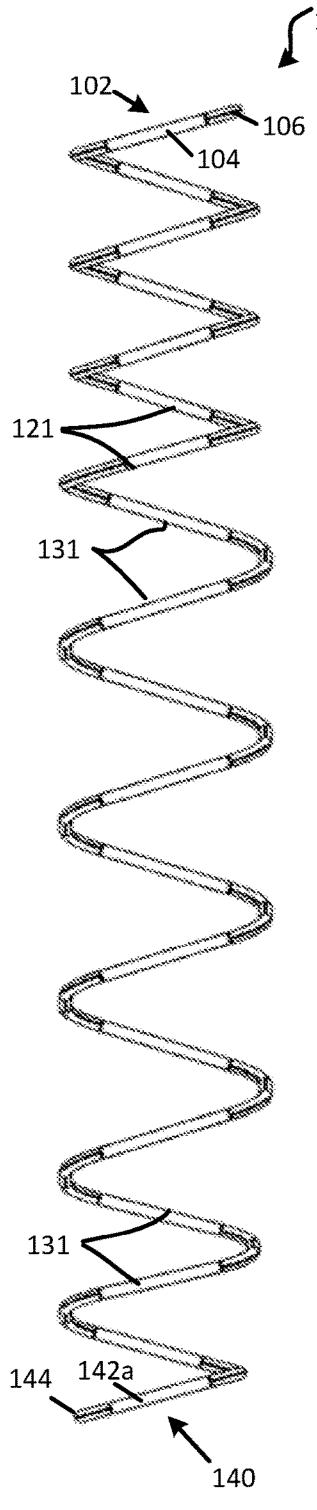


FIG. 1B

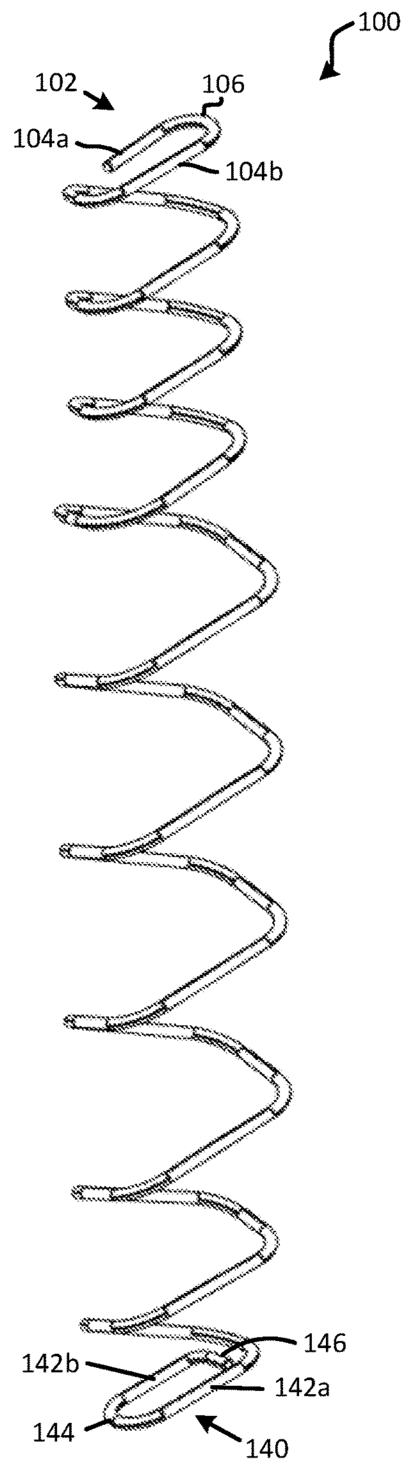
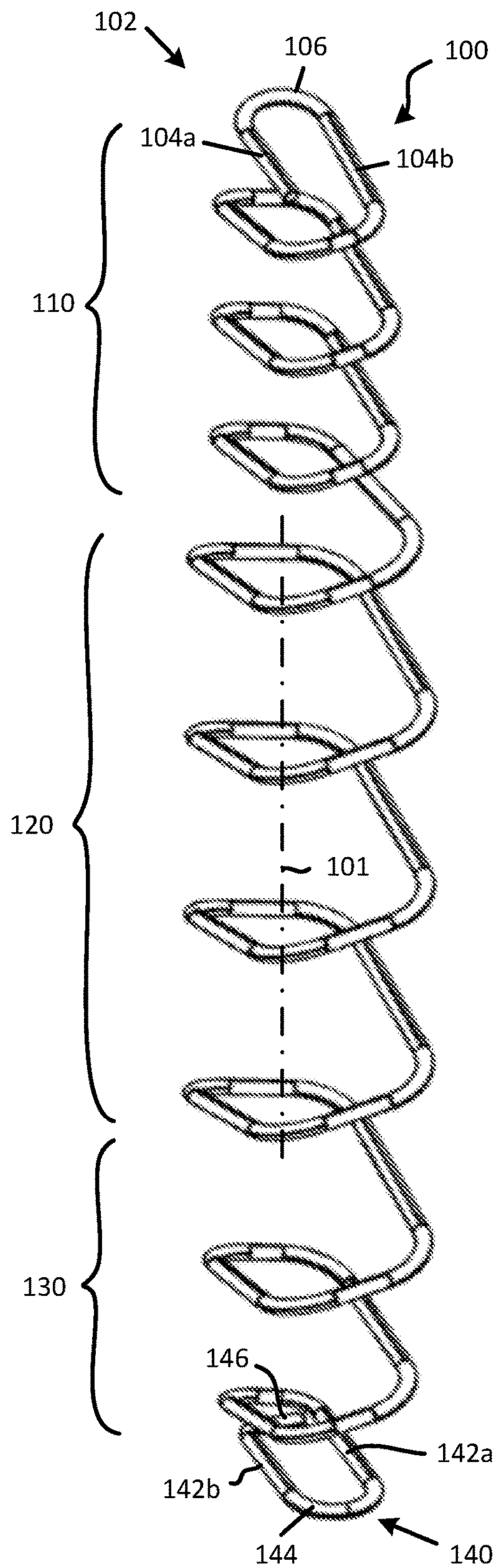


FIG. 1C



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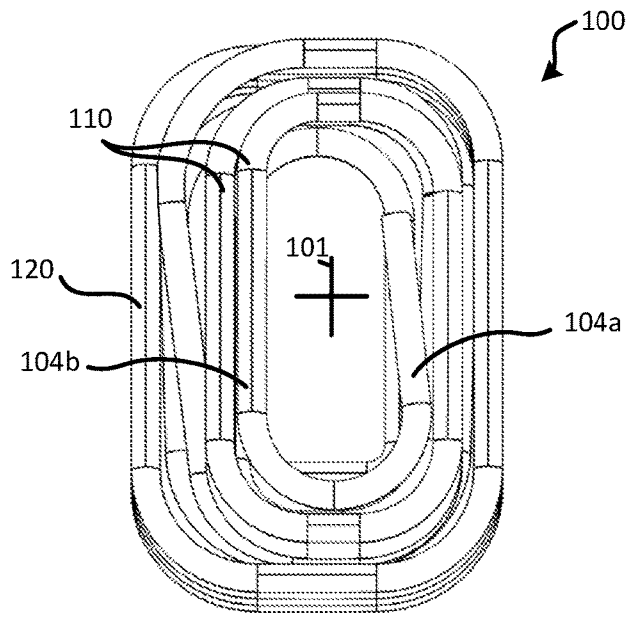

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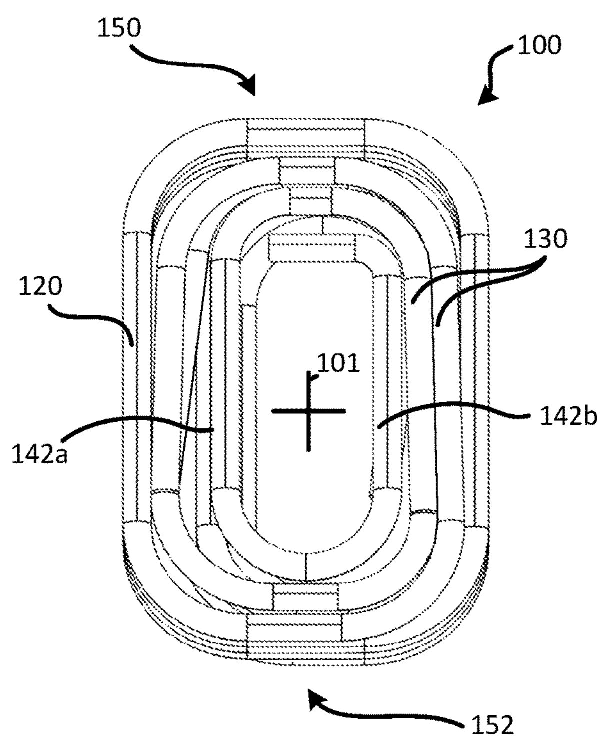

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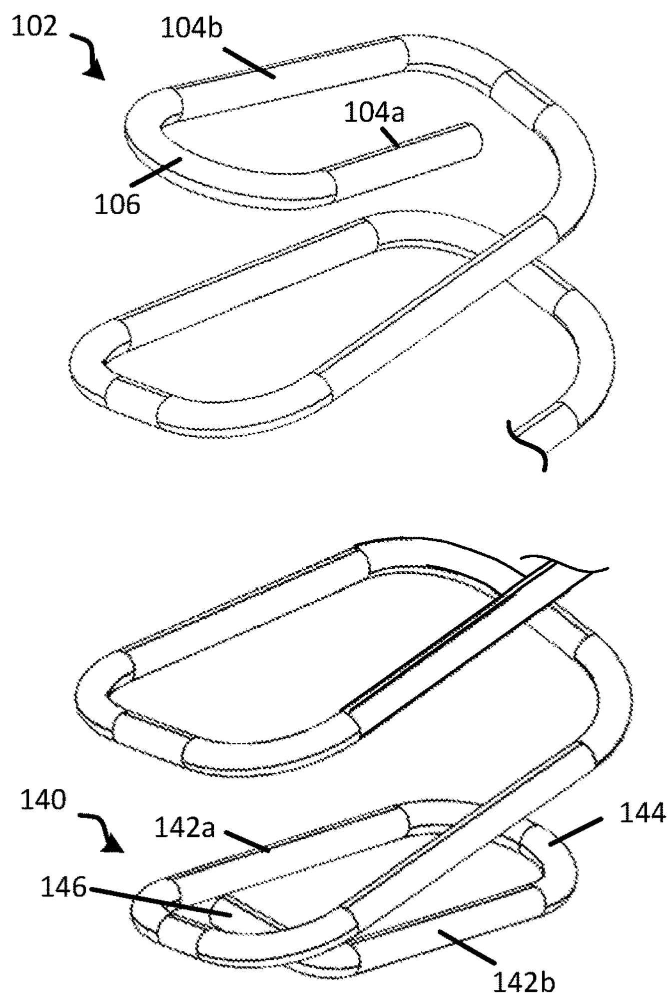
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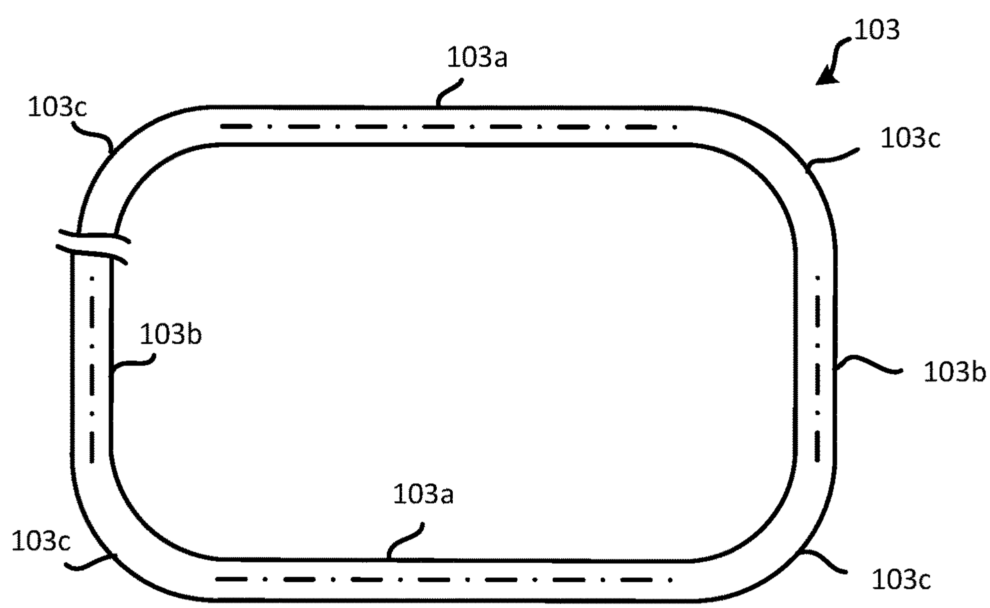
FIG. 1G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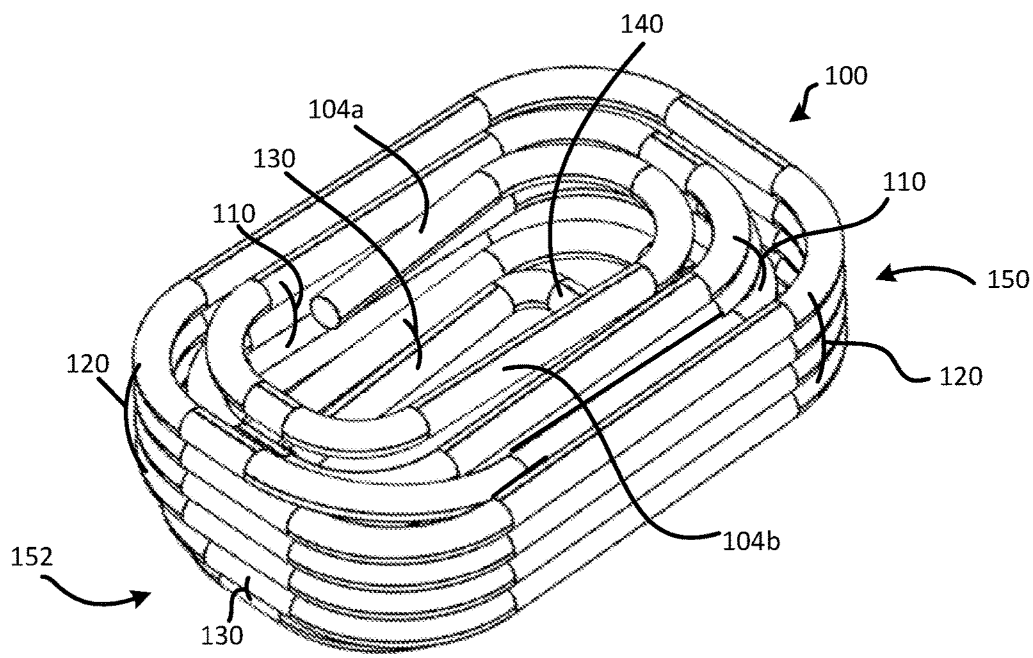
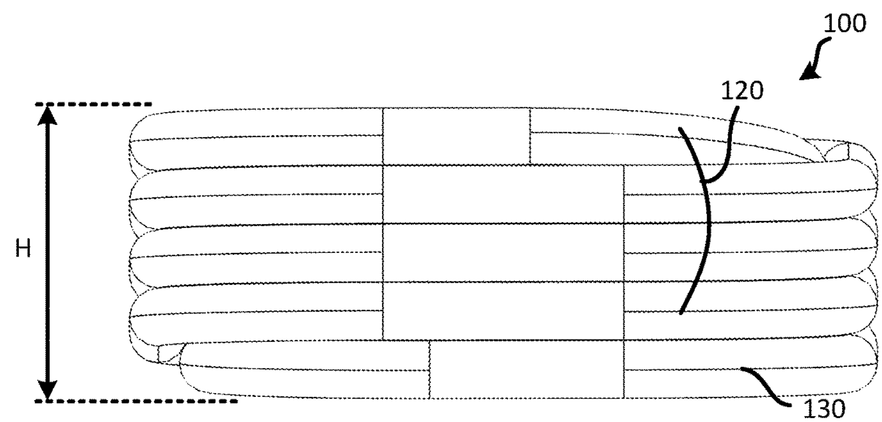


FIG. 2A



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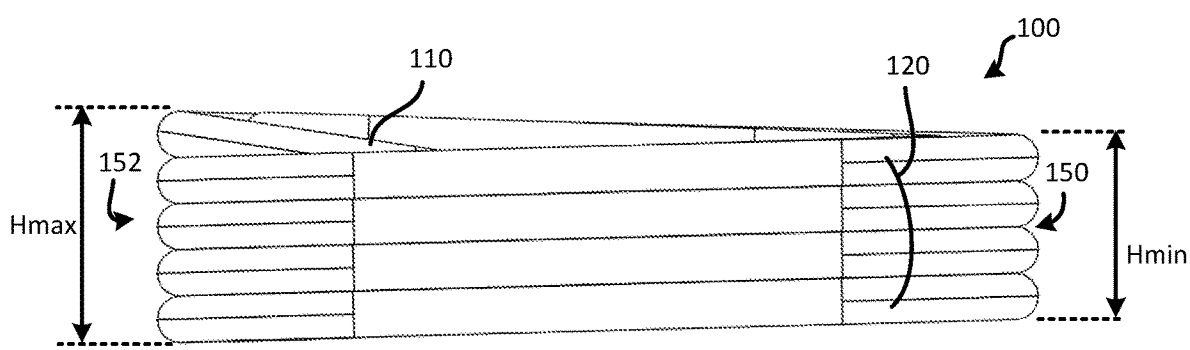

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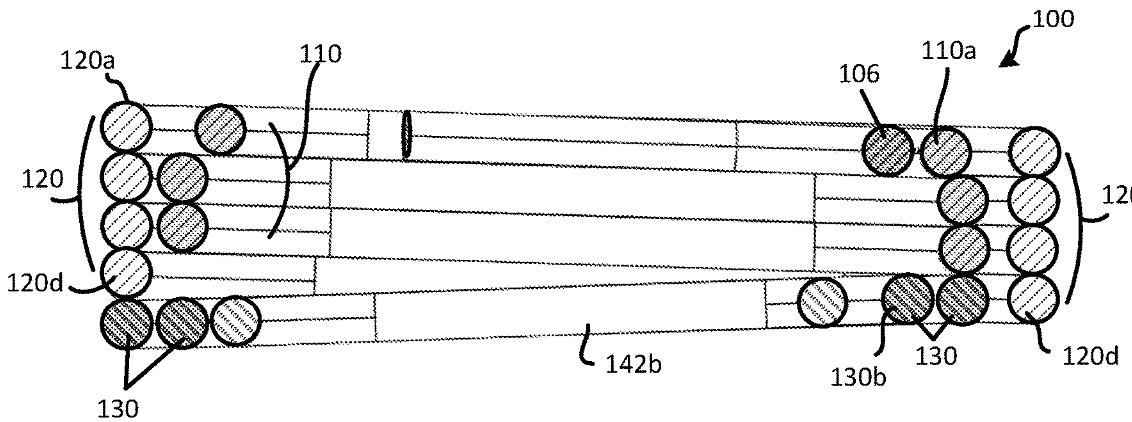

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FIG. 2D

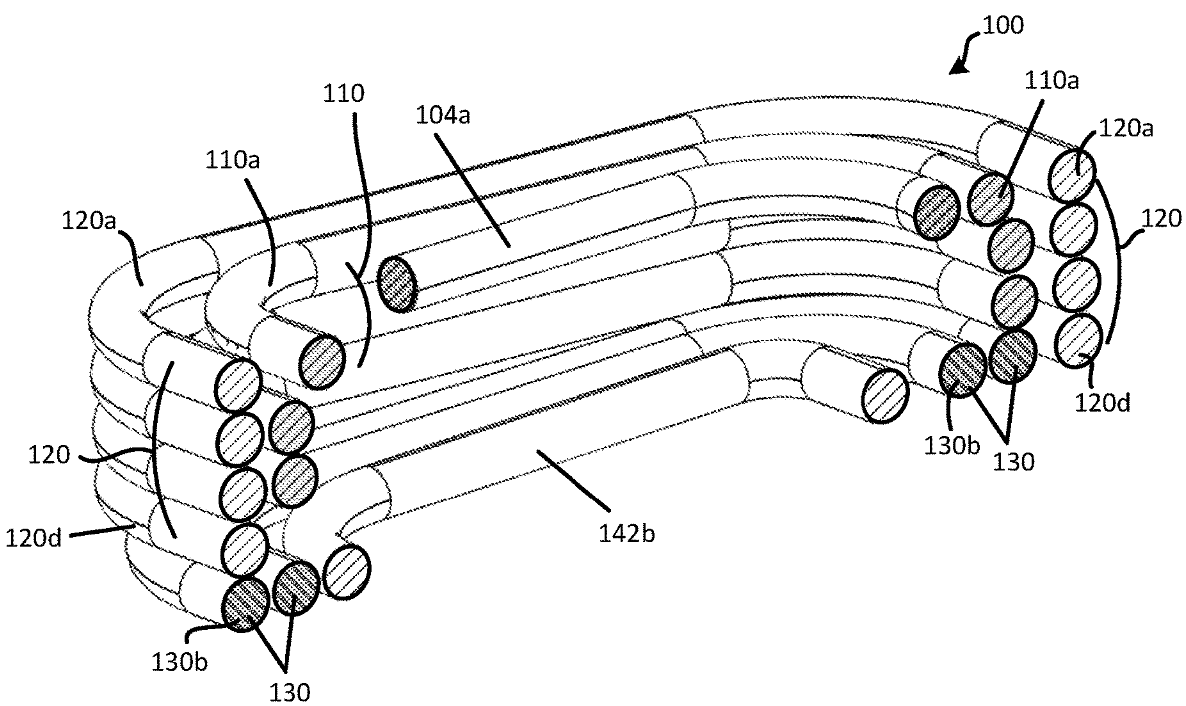

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FIG. 2E

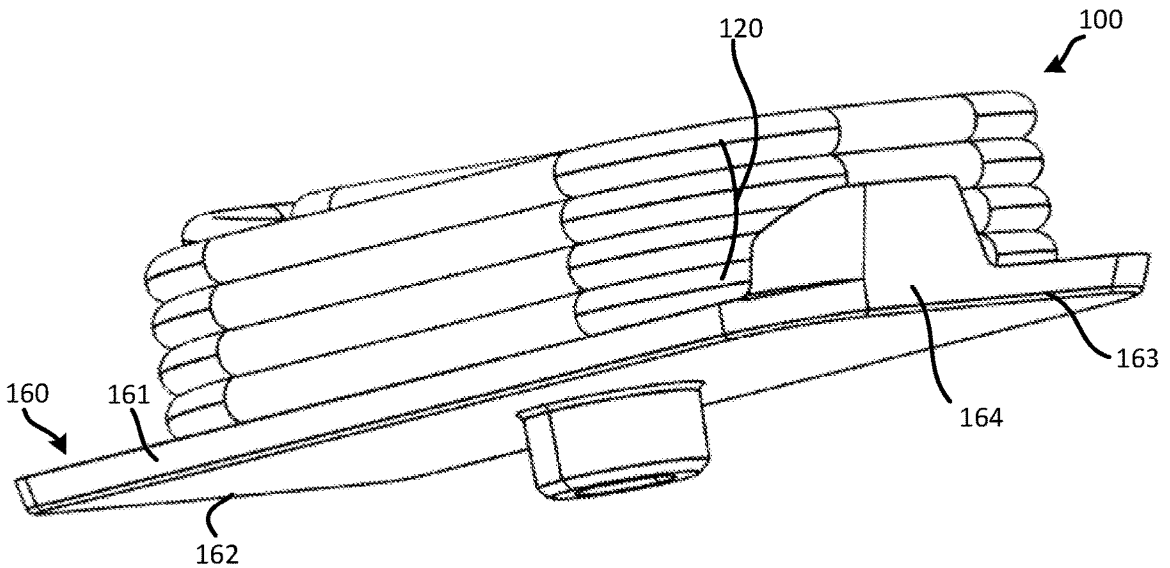
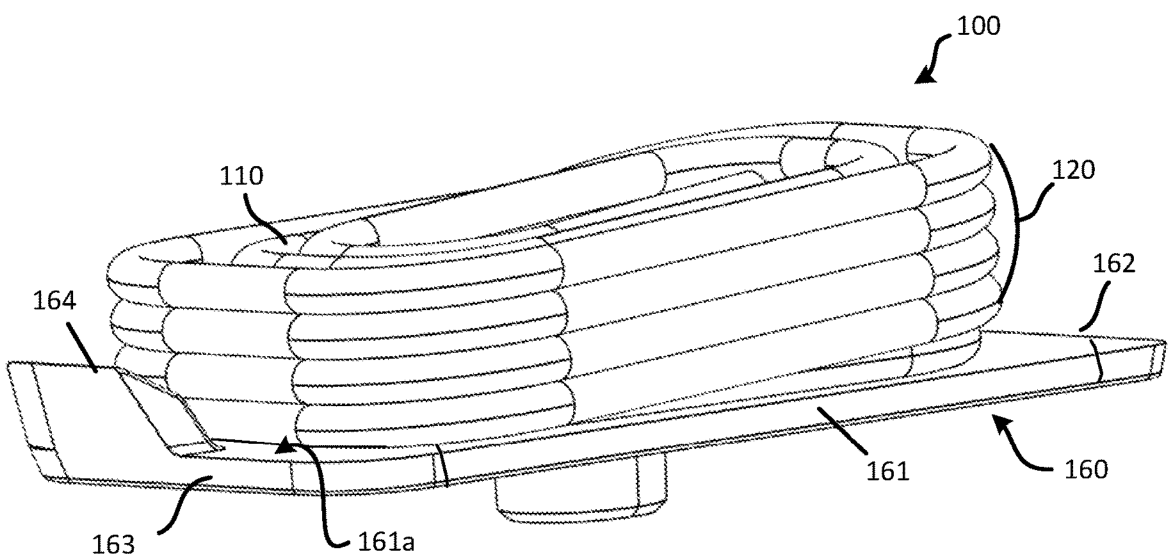


FIG. 3A



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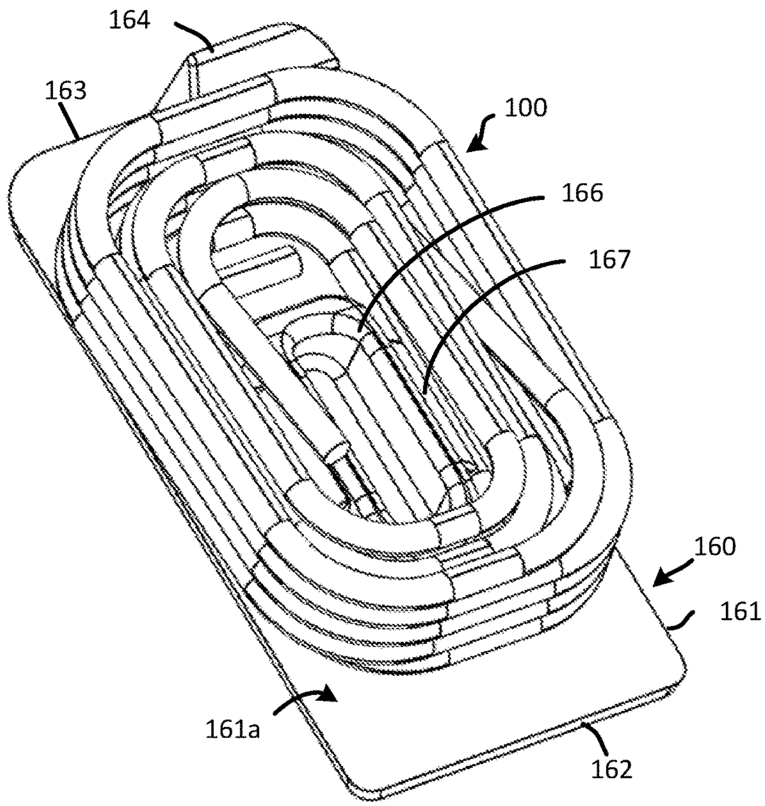
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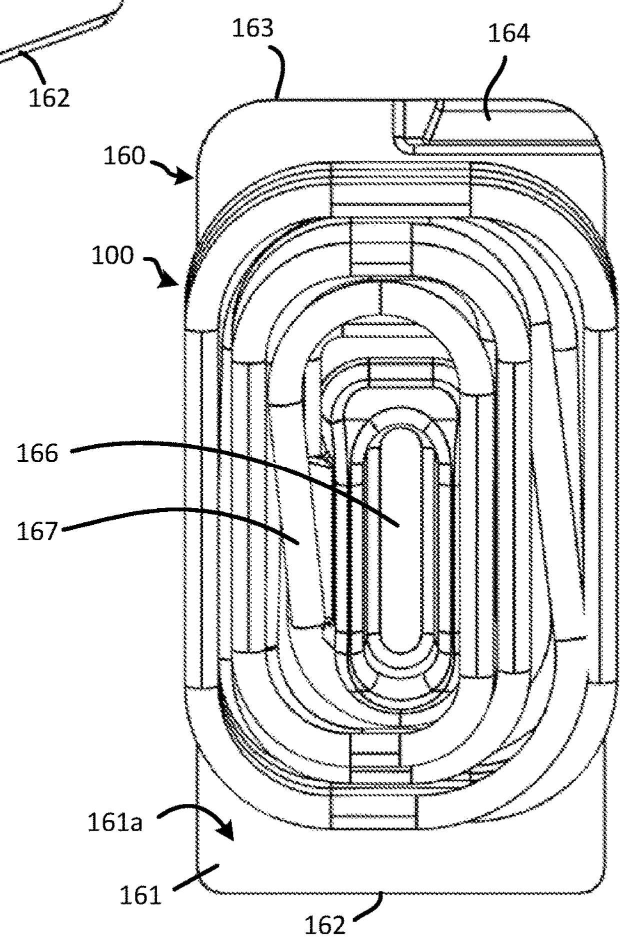
FIG. 3C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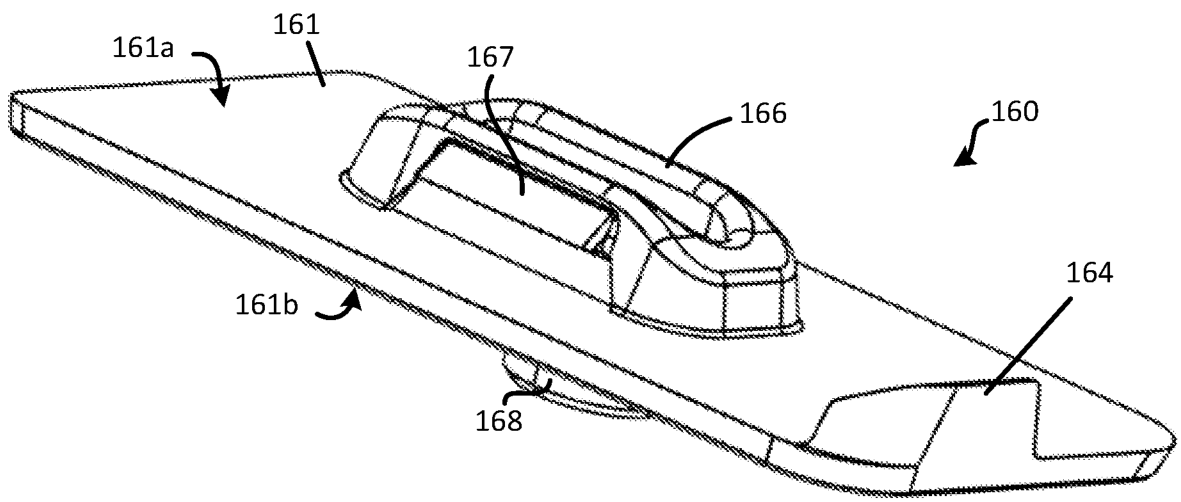

FIG. 4A

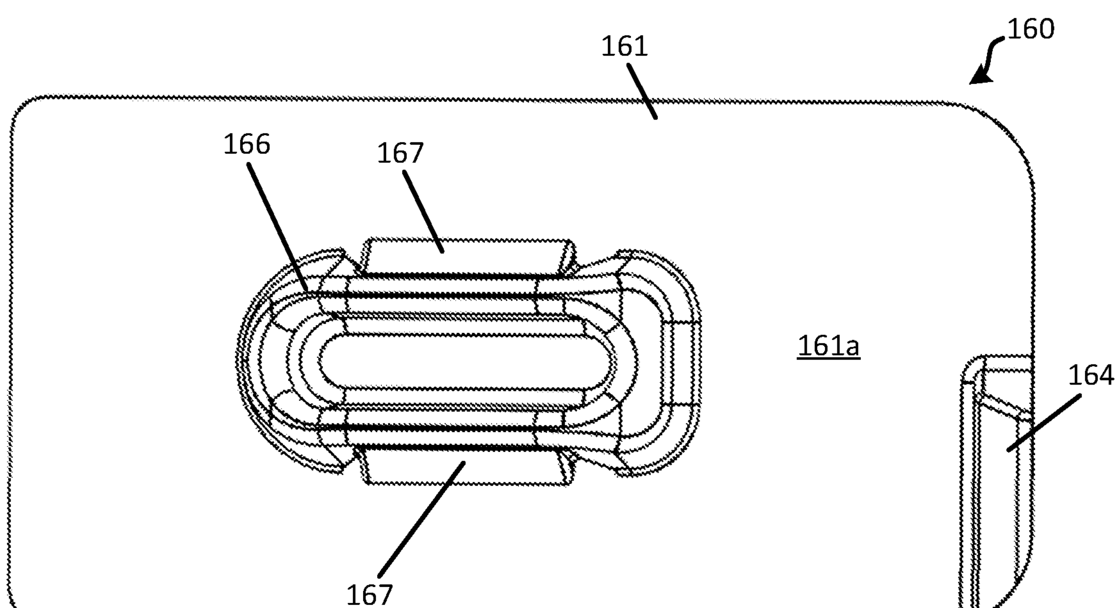

FIG. 4B

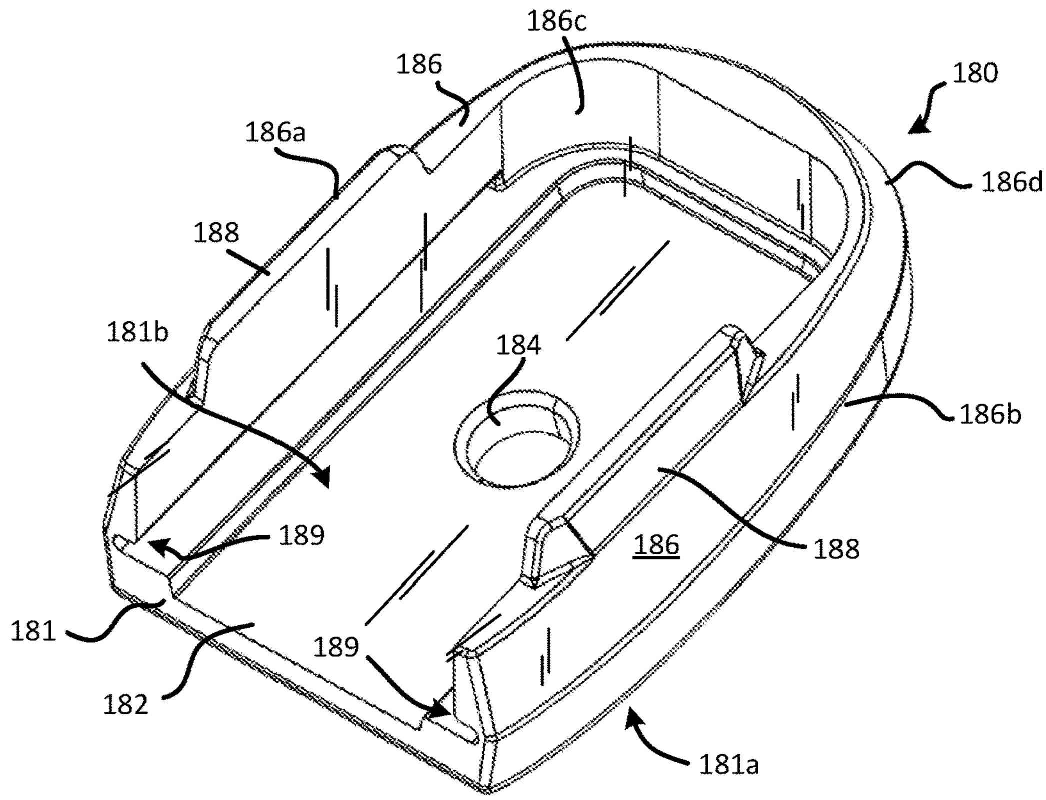
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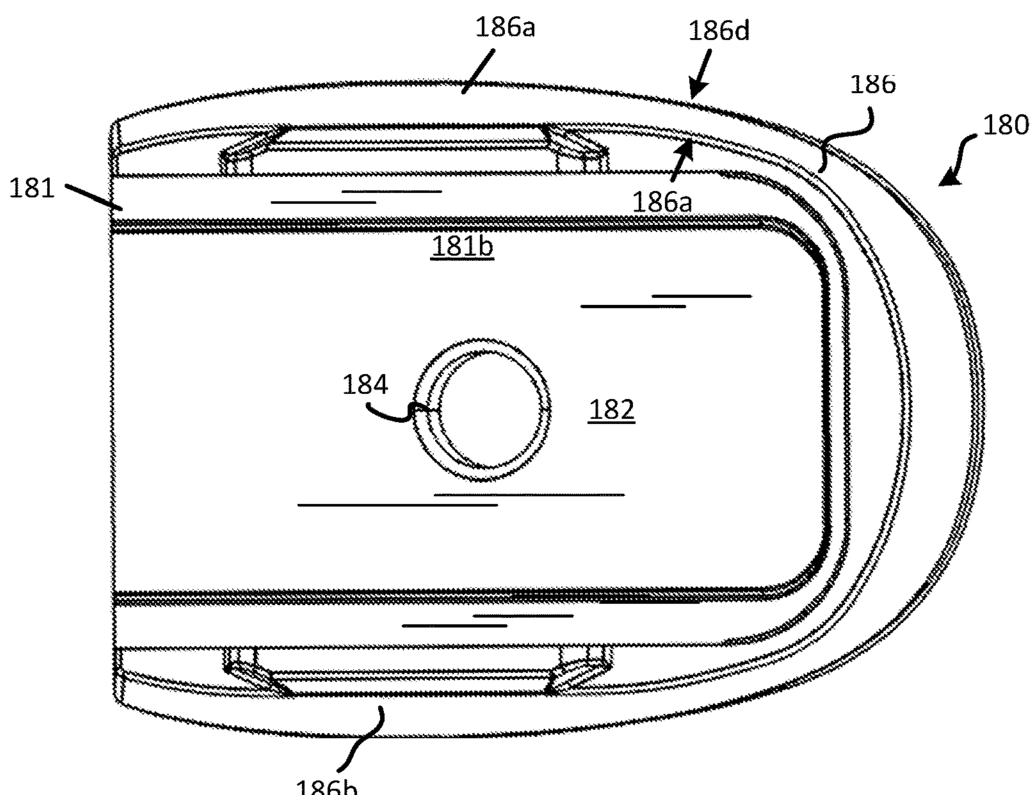
FIG. 5A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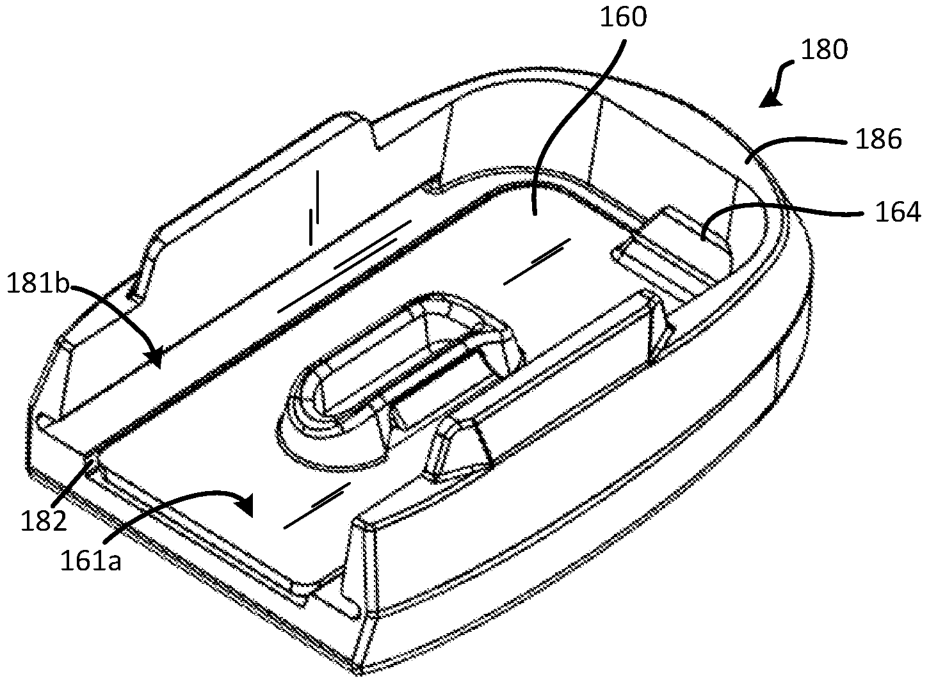
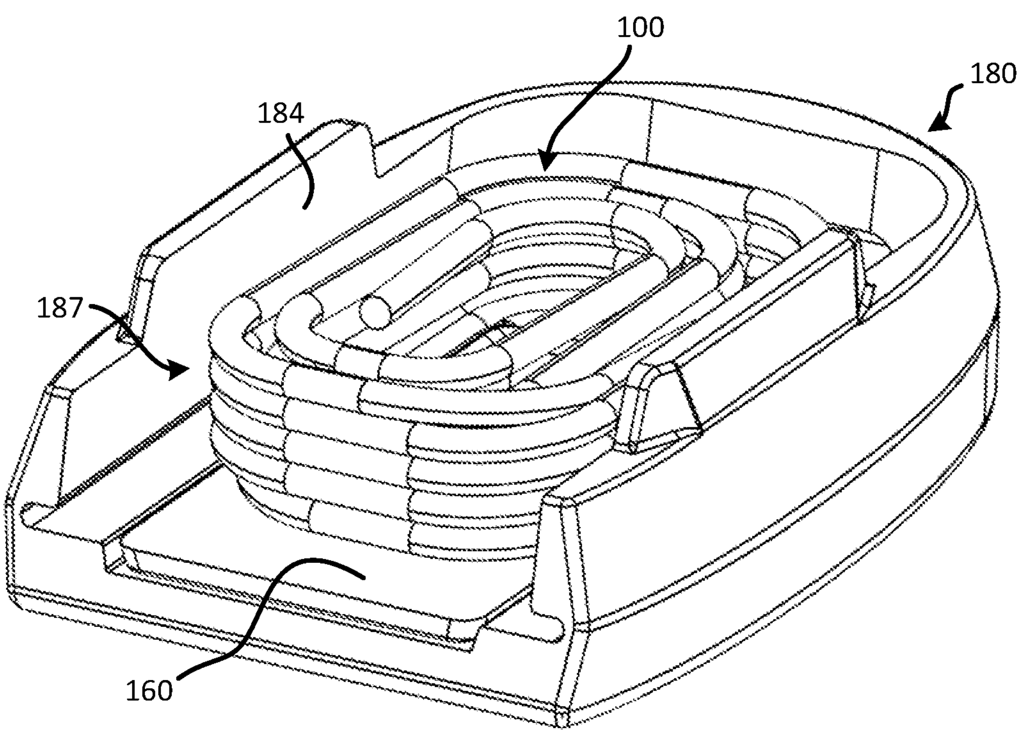


FIG. 6A



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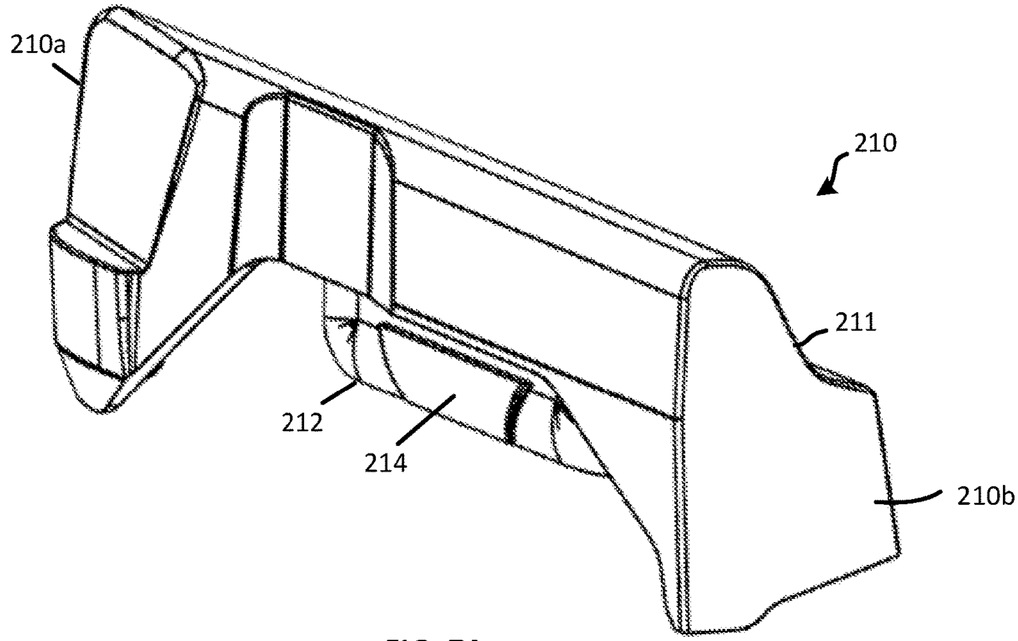


FIG. 7A

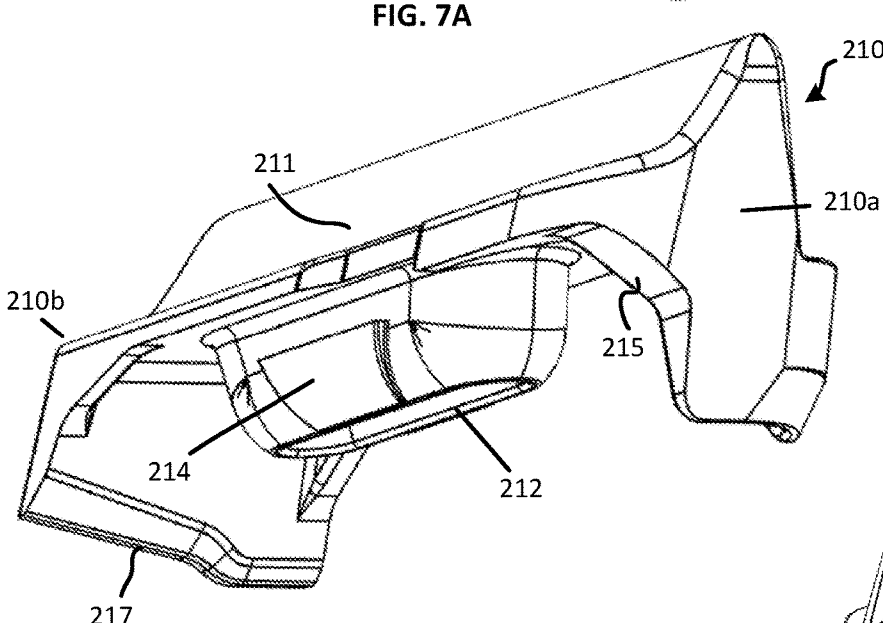


FIG. 7B

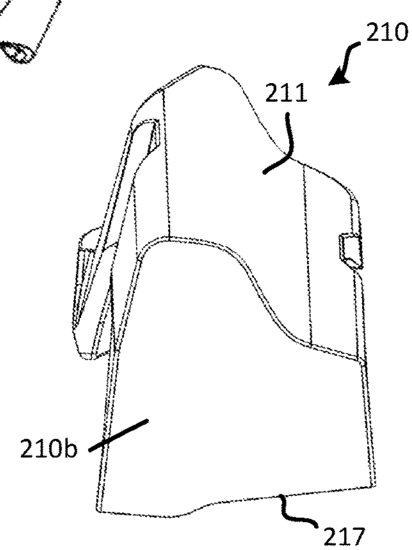


FIG. 7C

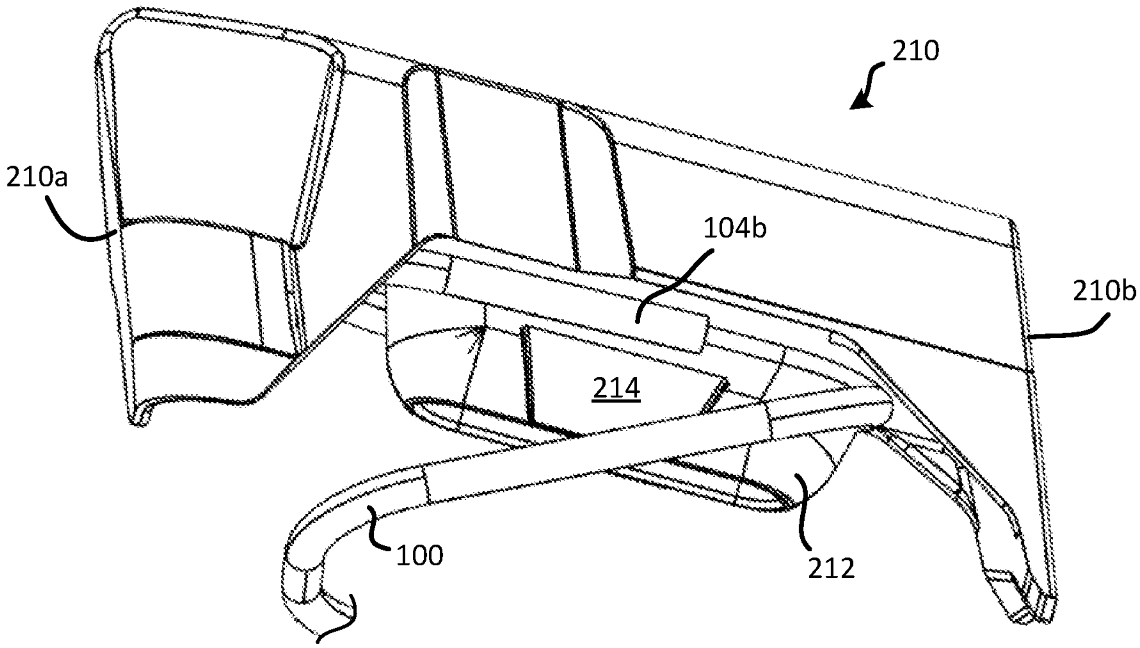


FIG. 8

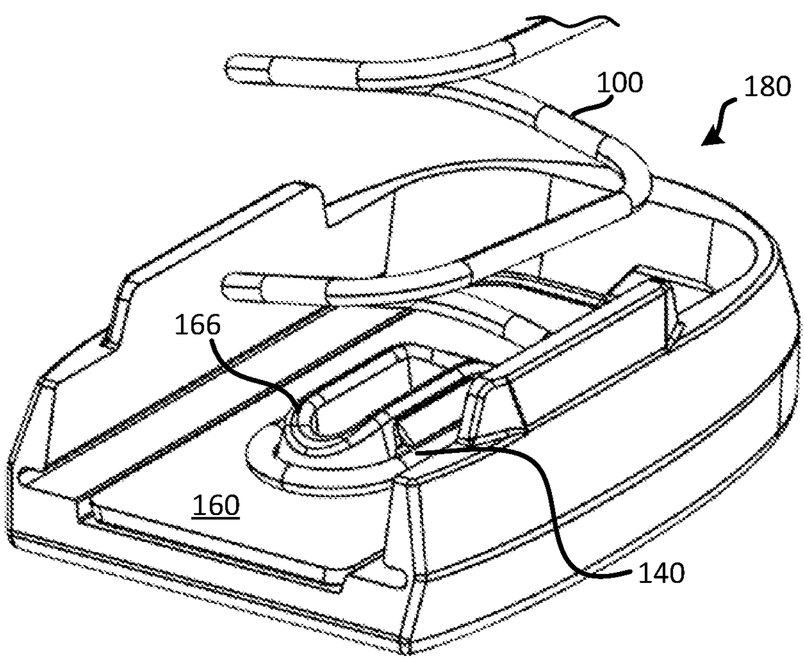


FIG. 9

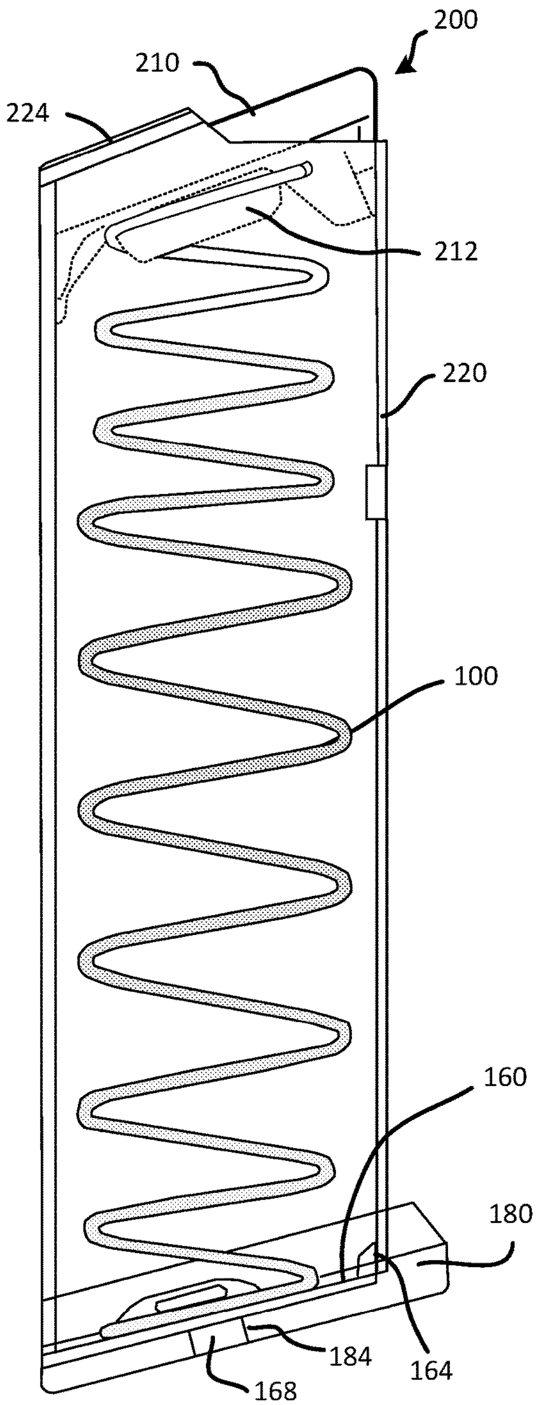


FIG. 10

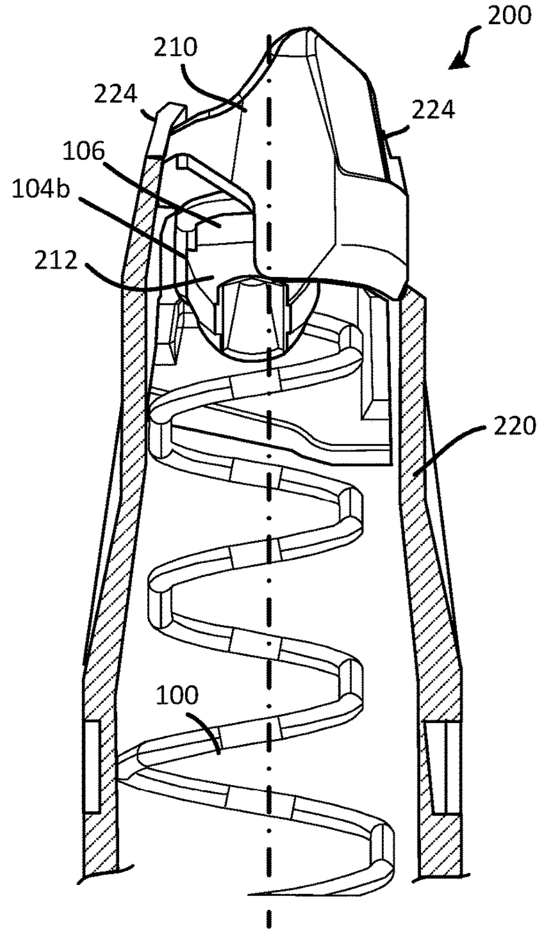
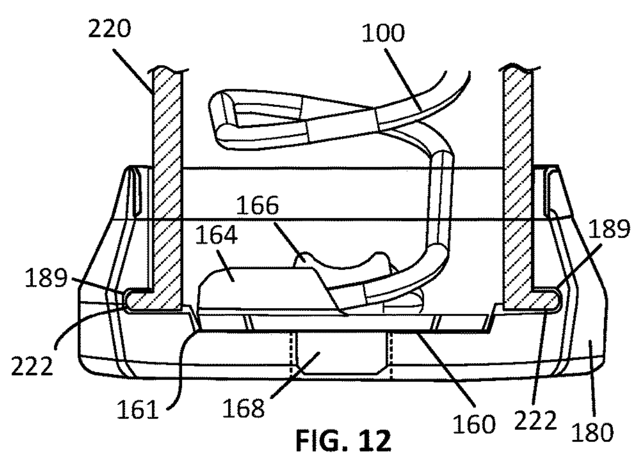


FIG. 11



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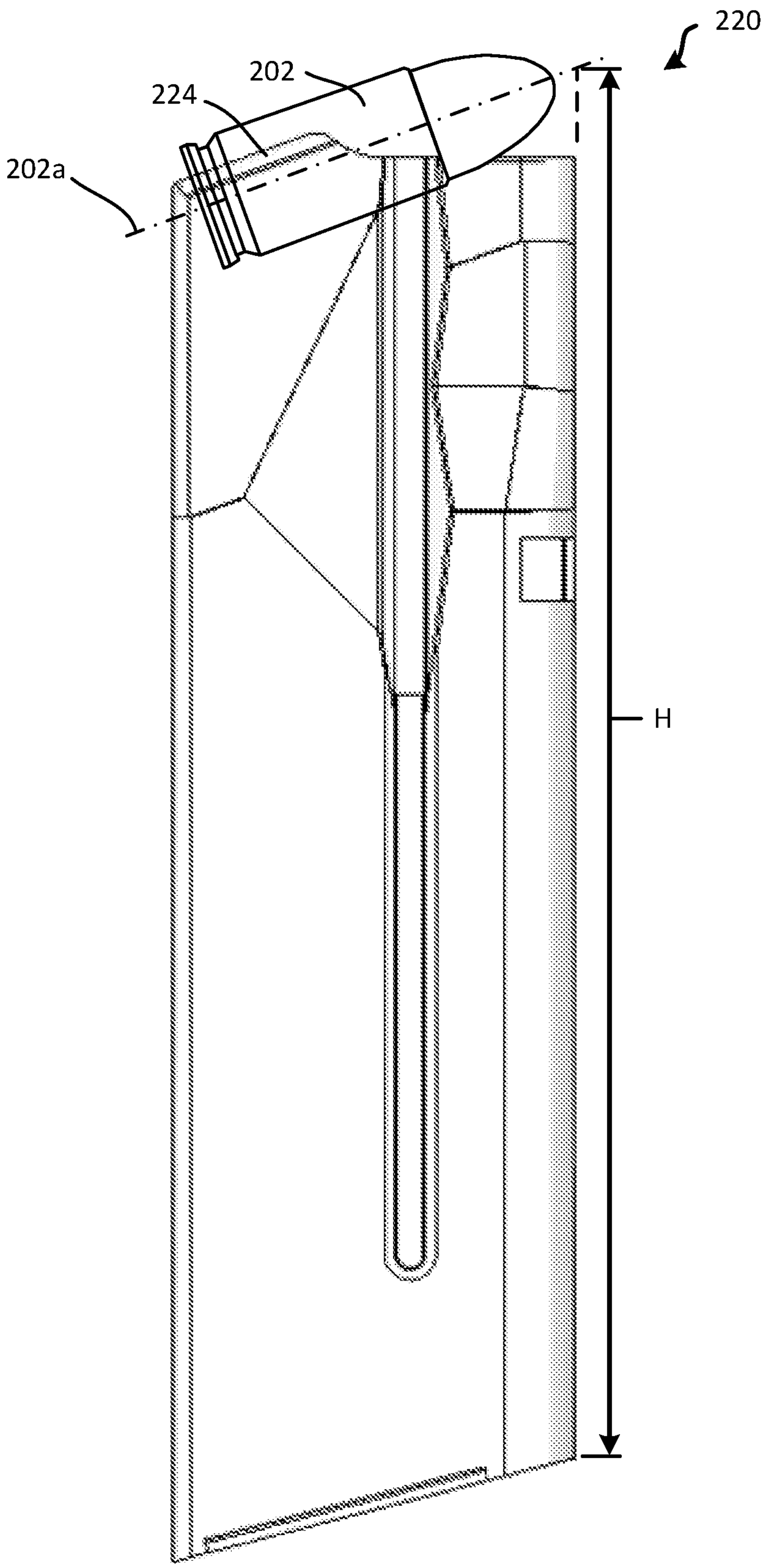

FIG. 13

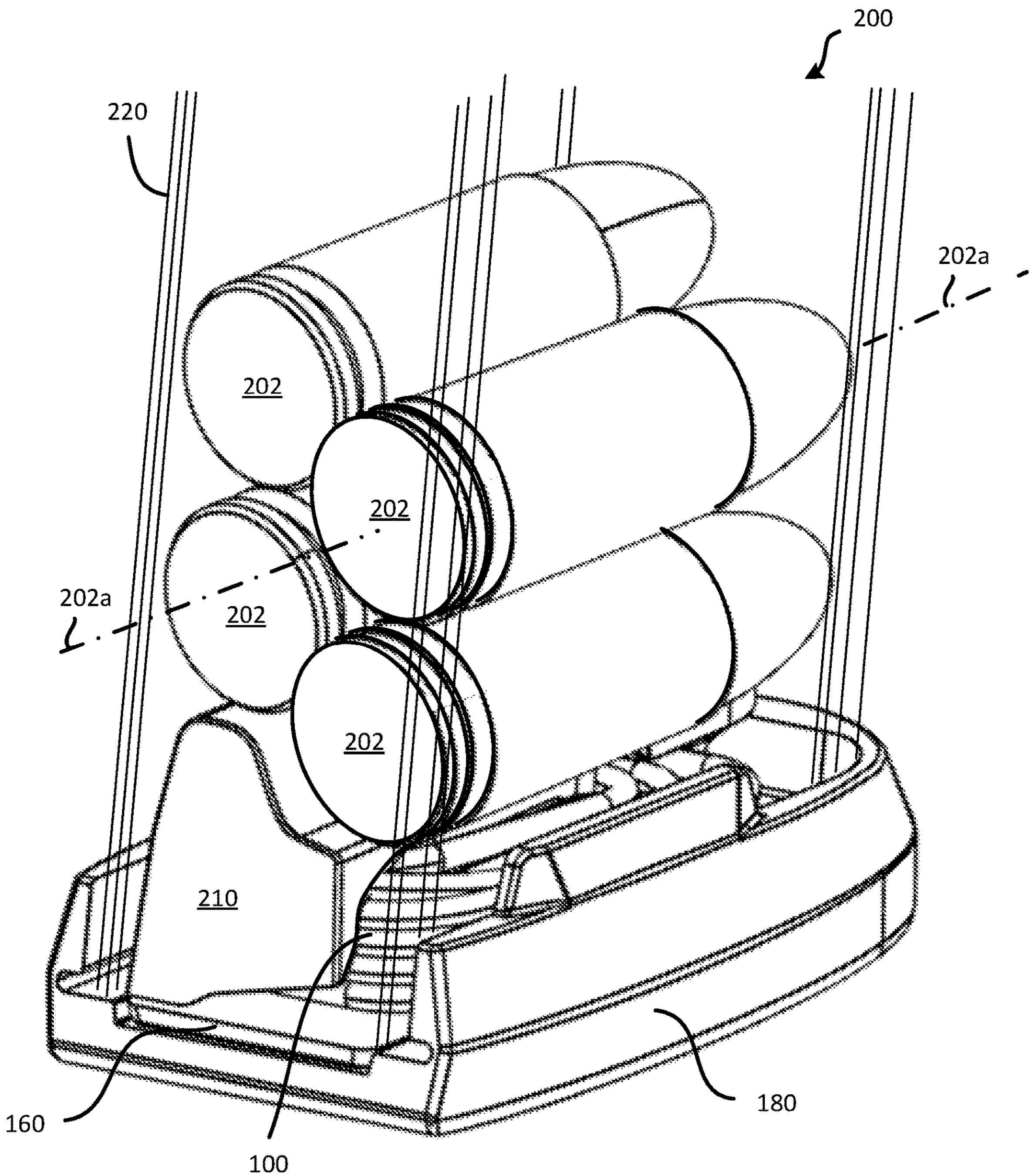

FIG. 14

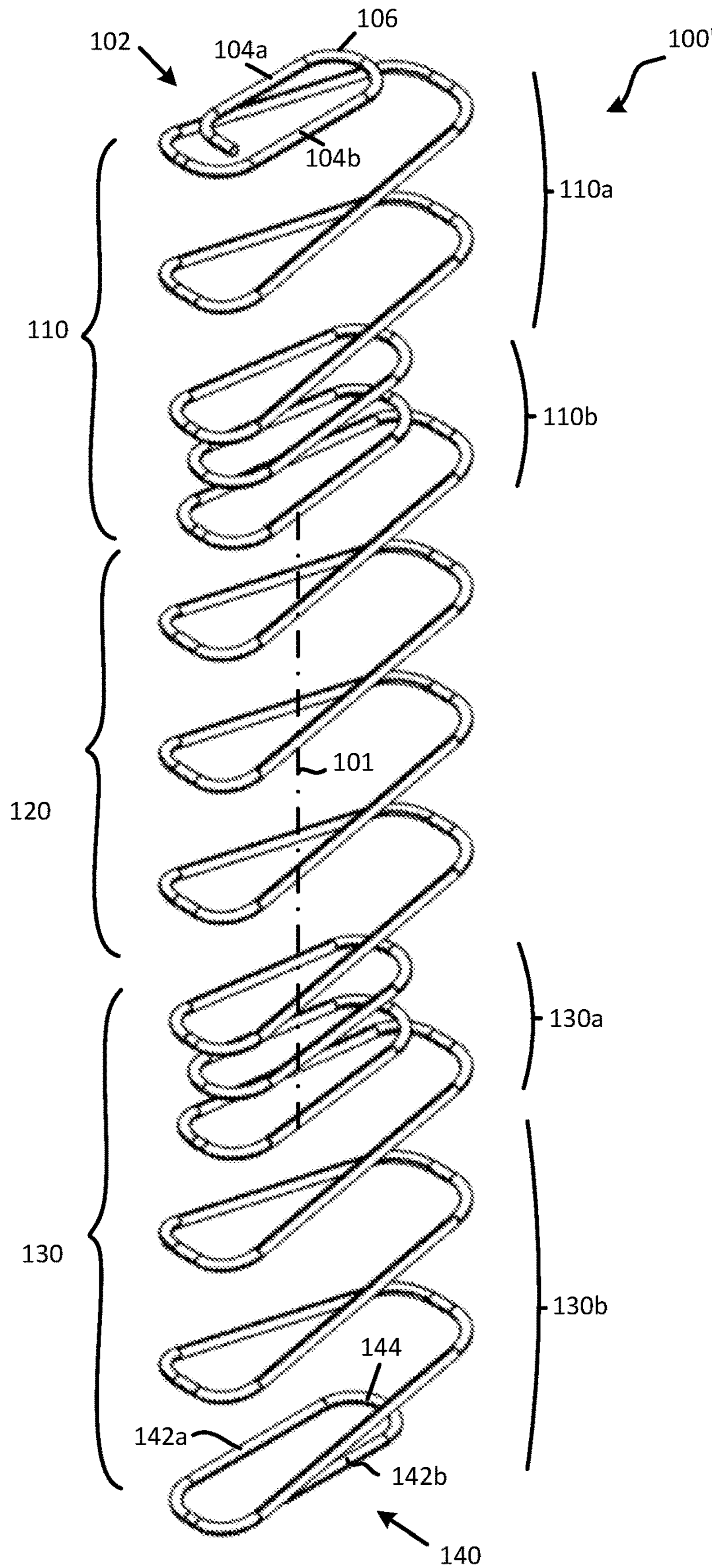

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FIG. 15A

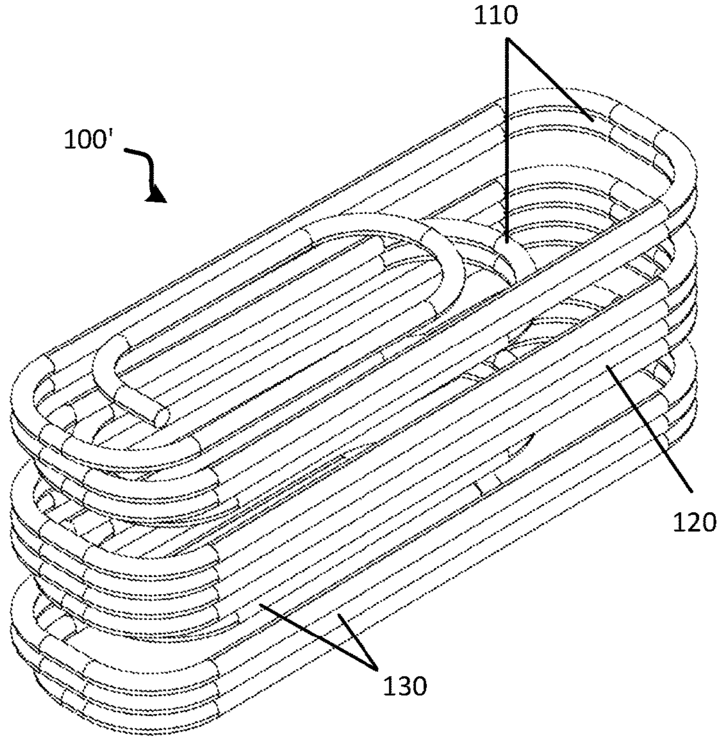

FIG. 15B

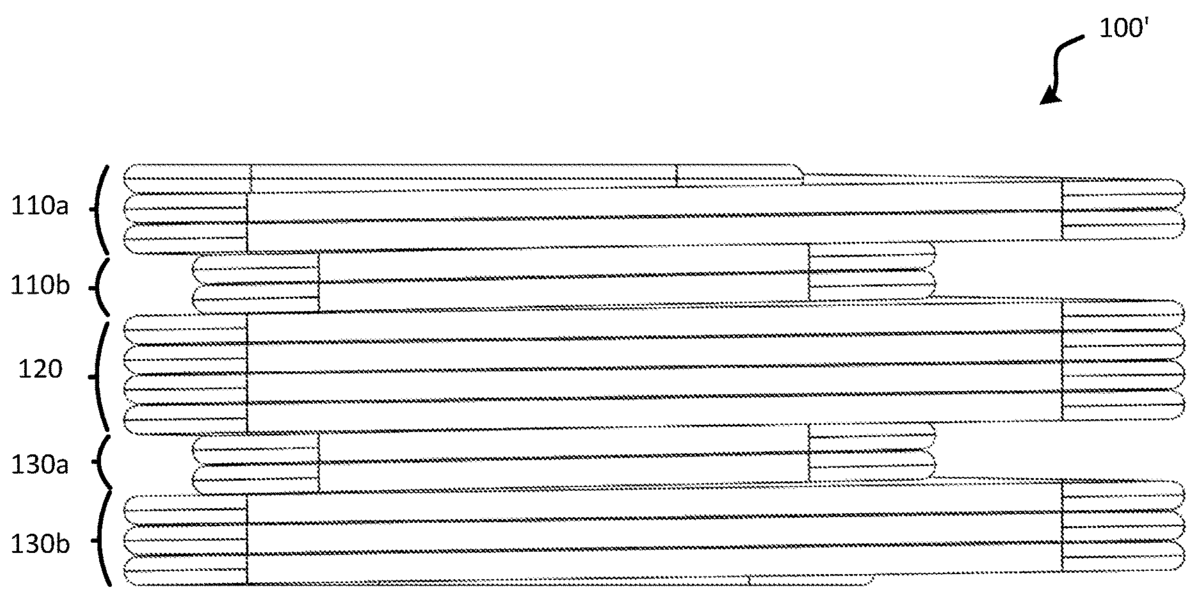

FIG. 15C

MAGAZINE SPRING AND MAGAZINE ASSEMBLY

TECHNICAL FIELD

The present disclosure relates generally to components for firearms magazines, and more particularly to a spring for a firearms magazine and a magazine including the spring.

BACKGROUND

Firearms design involves many non-trivial challenges. Traditionally, semiautomatic handguns have been made with a metal frame having a grip portion that defines a magazine well configured to retain a magazine. Autoloading rifles similarly have a receiver that defines a magazine well configured to receive a magazine. Whether for use in a handgun or a long gun, an ammunition magazine can retain cartridges in a single vertical stack, in an offset double stack, or a combination of single and double stacks. A magazine includes a magazine tube generally of rectangular cross-sectional shape that extends from a bottom end to an open upper end that defines feed lips. The bottom end of the tube can be closed by a removable baseplate. A magazine spring is retained in the magazine tube in a compressed state between the baseplate and a follower, where the spring biases the follower, and any ammunition in the magazine, towards the feed lips at the upper end of the magazine tube. When installed in the magazine well, the top-most round is positioned to be stripped from the magazine and loaded into the chamber during the reloading cycle.

SUMMARY

The present disclosure is directed to a spring for an ammunition magazine, a components kit including the spring, and a magazine assembly including the spring. In one example embodiment, the spring is configured for a handgun magazine and includes upper coils of a smaller size that can nest within larger coils of a rectangular coil shape. In another example, the components kit includes a spring, a spring plate, and a magazine base plate, and is configured to replace components of an existing magazine for the purpose of increasing the magazine capacity or simply replacing parts. A magazine spring is discussed with reference to a handgun magazine, but the present disclosure is not so limited, and the concepts disclosed herein apply to magazine springs for rifles and other long guns. Numerous variations and embodiments will be apparent in light of the present disclosure.

The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the drawings, specification, and claims. Moreover, it should be noted that the language used in the specification has been selected principally for readability and instructional purposes and not to limit the scope of the disclosed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A illustrates a front view of a spring for a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. 1B illustrates a side view of the spring of FIG. 1A.

FIG. 1C illustrates a perspective view of the spring of FIG. 1A.

FIG. 1D illustrates another perspective view of the spring of FIG. 1A.

FIG. 1E illustrates a top plan view of the spring of FIG. 1A.

FIG. 1F illustrates a bottom plan view of the spring of FIG. 1A.

FIG. 1G illustrates top and bottom end portions of a spring for a handgun magazine, in accordance with some embodiments of the present disclosure.

FIG. 1H illustrates an example of a rectangular spring coil, in accordance with an embodiment of the present disclosure.

FIG. 2A illustrates a perspective view of a spring in a compressed condition, in accordance with an embodiment of the present disclosure.

FIG. 2B illustrates a rear-end view of the spring of FIG. 2A.

FIG. 2C illustrates a side view of the spring of FIG. 2A.

FIG. 2D illustrates a cross-sectional side view of the spring of FIG. 2A.

FIG. 2E illustrates a cross-sectional perspective view of the spring of FIG. 2A.

FIG. 3A illustrates a bottom, front, and side perspective view of a spring and spring plate, in accordance with an embodiment of the present disclosure.

FIG. 3B illustrates a side and front perspective view of a spring and spring plate, in accordance with an embodiment of the present disclosure.

FIG. 3C illustrates a top perspective view of the spring and spring plate of FIG. 3A.

FIG. 3D illustrates a top plan view of the spring and spring plate of FIG. 3A.

FIG. 4A illustrates a top, front, and side perspective view of a spring plate for a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. 4B illustrates a top plan view of the spring plate of FIG. 4A.

FIG. 5A illustrates a top, side, and rear perspective view of a base plate for a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. 5B illustrates a top plan view of the base plate of FIG. 5A.

FIG. 6A illustrates a top, side, and rear perspective view of a base plate and spring plate for a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. 6B illustrates a rear and side perspective view of a base plate, spring plate, and spring in a compressed condition, in accordance with an embodiment of the present disclosure.

FIG. 7A illustrates a side and rear perspective view of a follower for a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. 7B illustrates a bottom, front, and side view of the follower of FIG. 7A.

FIG. 7C illustrates a rear view of the follower of FIG. 7A.

FIG. 8 illustrates a bottom and side perspective view showing a top end portion of a spring engaging the spring protrusion of a follower, in accordance with an embodiment of the present disclosure.

FIG. 9 illustrates a top, side, and rear perspective view showing a lower portion of a magazine spring having a bottom end portion around a protrusion on a spring plate, and the spring plate recessed into a base plate, in accordance with an embodiment of the present disclosure.

FIG. 10 illustrates a side view of a handgun magazine assembly, in accordance with an embodiment of the present disclosure.

FIG. **11** illustrates a front and partial cross-sectional view of an upper portion of a handgun magazine, in accordance with an embodiment of the present disclosure.

FIG. **12** illustrates a front view of a lower portion of a handgun magazine assembly, in accordance with an embodiment of the present disclosure.

FIG. **13** illustrates a side view of a magazine tube and ammunition cartridge, in accordance with an embodiment of the present disclosure.

FIG. **14** illustrates a rear perspective view showing components in the lower portion of a magazine assembly when the magazine is loaded to capacity, in accordance with an embodiment of the present disclosure.

FIG. **15**A illustrates a perspective view of a magazine spring for a rifle magazine in an uncompressed state, in accordance with another embodiment.

FIG. **15**B illustrates an isometric view of the magazine spring of FIG. **15**A in a mostly compressed state, in accordance with an embodiment.

FIG. **15**C illustrates a side view of the magazine spring of FIG. **15**B.

The Figures depict various embodiments of the present disclosure for purposes of illustration only. For purposes of clarity, not every component may be labeled in every drawing. Furthermore, as will be appreciated, the figures are not necessarily drawn to scale or intended to limit the present disclosure to the specific configurations shown. Numerous variations, configurations, and other embodiments will be apparent from the following detailed discussion.

DETAILED DESCRIPTION

Disclosed is a spring for an ammunition magazine, a components kit including the spring, and a magazine assembly including the spring. In accordance with one embodiment, a spring for a handgun magazine includes a top attachment leg, upper coils below the top attachment leg, intermediate coils below the upper coils, and a bottom attachment leg below the intermediate coils, where the upper coils are sized and shaped to nest within the plurality of intermediate coils when the spring is fully compressed. In some such embodiments, the spring includes one or more lower coils between the bottom attachment leg and the intermediate coils. In some embodiments, at least two upper coils and/or at least two lower coils can nest within the intermediate coils. The spring can have coils of oval or square shape, or a combination of oval and square coils, in accordance with some embodiments.

In some embodiments, the magazine spring has unique rectangular coils in addition to nesting features that reduce the solid height of the spring. Rectangular coil shapes tend to stack more neatly and tend to nest easier since the rectangular coil has a greater area than an oval coil of the same length and width. Also, rectangular spring coils can be designed to increase the effective length of each coil, resulting in increased deflection and pitch. Such rectangular coil design also can reduce the peak stresses along the spring by distributing the stress along a greater coil length. Attachment coils at the top and bottom of the spring can nest into the adjacent working coils when the spring is compressed so that the attachment legs do not add to the solid height of the spring. Also, the smaller upper coils can nest within the larger intermediate coils, and smaller lower coils (when present) can nest at least partially within the intermediate coils when the spring is compressed. For example, front portions of the lower coils nest within the intermediate coils, but rear portions of the lower coils need not nest in all embodiments since the floorplate may not be oriented perpendicularly with the magazine tube axis and therefore allows additional space for non-nesting rear portions of the spring. Some or all of these features can be combined to result in a spring having a reduced coil count, an increased coil pitch, and/or improved efficiency. In some embodiments, the solid height of the magazine spring provides a stop between the follower and the floorplate.

In addition to nesting features of the spring, a magazine assembly can include one or both of a spring plate that is recessed into the magazine base plate and a follower that is shaped to reduce vertical height of the assembly. The follower can be constructed to overlap the spring when the spring is compressed, reducing vertical height of the spring and follower.

Advantageously, a magazine spring and magazine assembly of the present disclosure can include combinations of features to increase magazine capacity by 1-2 rounds for a handgun magazine of a given tube length. For example, the capacity of a magazine originally configured to hold 15 rounds can be increased to hold 16 or 17 rounds by retrofitting with a magazine components kit. Examples of handgun magazines that can benefit from components disclosed herein include the 9 mm P320 and P365 magazines made by Sig Sauer Inc. Magazines for rifle ammunition can also benefit from the concepts disclosed herein. Numerous variations and embodiments will be apparent in light of the present disclosure.

Overview

Depending on the intended use, ammunition capacity can be an important factor when selecting a handgun. Semiautomatic handguns use a removable box magazine that is received in the magazine well defined in the gun's handgrip. Handgun magazines traditionally have been available in two main configurations, namely, single stack and double stack. In single-stack magazines, all cartridges are aligned in a single column with each cartridge arranged on top of the cartridge below it. Single-stack box magazines enable the grip of the handgun to have a lateral thickness of about one inch (~2.5 cm), sometimes slightly less, depending on chambering and the particular grips installed on the frame. A single-stack magazine is often found in handguns with a smaller thickness. Another approach to increasing magazine capacity is to structure the magazine tube to hold two offset columns of cartridges, referred to as a "double stack" magazine. Many full-size handguns include a double stack magazine and can have a capacity of 10, 12, 15, or 17 rounds, for example. The capacity can be increased slightly by adding some length to the magazine baseplate, also referred to as an extended baseplate. However, increasing the grip's lateral thickness or adding length to the grip are approaches that increase the overall size and mass of the handgun. This increased size makes it more difficult to effectively conceal the handgun.

It would be desirable to increase magazine capacity without adding to the overall size of a magazine. The present disclosure addresses this need and others by providing a magazine spring with a reduced solid height. Increased magazine capacity can further be realized with features of other magazine components that save space in the magazine tube. In accordance with some embodiments, features of the spring and other magazine components reduce the vertical size of those components and increase the ammunition capacity compared to existing magazines using the same magazine tube. Numerous configurations and variations will be apparent in light of this disclosure.

As will be appreciated in light of the present disclosure, and in accordance with some embodiments, ammunition magazines configured as described herein are not limited to semiautomatic handguns and can be utilized with any of a wide range of firearms. In accordance with some example embodiments, a magazine configured as described herein can be utilized with a semiautomatic handgun chambered in .380 Auto, 9 mm Luger, .357 SIG, 10 mm Auto, .40 S&W, .45 ACP ammunition, or other suitable ammunition. Other suitable host firearms and ammunition will be apparent in light of this disclosure.

As discussed herein, terms referencing direction, such as upward, downward, vertical, horizontal, left, right, front, back, etc., are used for convenience to describe embodiments of a magazine in an upright orientation. Embodiments according to the present disclosure are not limited by these directional references and it is contemplated that magazines of the present disclosure could be used in any orientation. Also note that the spring plate and base plate as disclosed herein can alternately be referred to as an inner base plate and outer base plate, respectively.

EXAMPLE EMBODIMENTS

FIGS. **1**A-**1**G illustrate various views of a magazine spring **100** in a relaxed state, in accordance with an embodiment of the present disclosure. FIG. **1**A is a front view, FIG. **1**B is a side view, FIGS. **1**C and **1**D are perspective views, FIG. **1**E is a top view, FIG. **1**F is a bottom view, and FIG. **1**G illustrates perspective views of individual spring portions. In its relaxed state, the spring **100** has a free length L that can be measured along a central spring axis **101** from a bottom end portion **140** to a top end portion **102**.

Spring **100** includes a top end portion **102** that includes straight segments **104***a*, **104***b* and turn **106**. Straight segment **104***b* is part of one of the upper spring coils **110** of a first size. Intermediate spring coils **120** of a second, larger size are below the upper spring coils **110** and connect to lower spring coils **130**. The lower spring coils **130** connect to straight segments **142***a*, **142***b*. Straight segment **142***a* is part of the lowermost lower spring coil **130** in some embodiments. Straight segment **142***b* can be an attachment leg that engages the magazine's spring plate.

Some or all of the upper spring coils **110** can nest within the intermediate spring coils **120** when the spring **100** is compressed. In some embodiments, at least two complete coils of the upper spring coils **110** nest (or can nest) within the intermediate spring coils **120**. In some embodiments, at least three complete upper spring coils **110** can nest within the intermediate coils **120**. Similarly, some or all of the lower spring coils **130** can nest within the intermediate spring coils **120** when the spring **100** is compressed. In some embodiments, at least two complete coils of the lower spring coils **130** nest (or can nest) within intermediate coils **120**. In some embodiments, at least three coils of the lower spring coils **130** can nest within intermediate coils **120**. For example, in a fully compressed state, portions of the lower spring coils **130** are nested within the intermediate coils **120** below the upper spring coils **110**, which are nested within the intermediate coils, such as shown in FIGS. **2**A-**2**E and discussed below in more detail. In this example, the spring **100** includes three and a half complete upper coils **110** (including straight segment **104***b*), four complete intermediate coils **120**, and two complete lower coils **130** (including straight segment **142***a*) for a total of 9.5 working coils. In other embodiments, the spring **100** has from 9-11 coils. Other numbers of coils can be used depending on the particular magazine tube length and other considerations, as will be appreciated.

In the example shown, part of top end portion **102** (e.g., straight segment **104***b* and part of turn **106**) and part of bottom end portion **140** (e.g., straight segment **142***a* and part of turn **144**) are part of working coils. Straight segments **104***a*, **104***b* are connected by a turn **106** of about 180°, where the straight segments **104***a*, **104***b* are oriented generally parallel to one another (e.g., ±10° from true parallel). The bottom end portion **140** includes straight segments **142***a*, **142***b* connected by a turn **144** of about 180°. Straight segment **142***b* connects to a terminal transverse leg **146** that extends towards straight segment **142***a*. Straight segment **142***b* is generally parallel to straight segment **142***a* (e.g., ±10° from true parallel) in this example.

In accordance with one embodiment, upper coils **110**, intermediate coils **120**, and lower coils **130** have a rectangular coil shape that includes straight side segments and straight end segments connected by curved corners. For example, upper coils **110** include straight side segments **111** and straight end segments **112** connected by curved segments **113**. In some embodiments, the straight side segments **111** of upper coils **110** have a length from 10-15 mm, such as about 14 mm; straight end segments **112** of upper coils **110** have a length from 1-5 mm, such as about 3 mm. Similarly, intermediate coils **120** include straight side segments **121** and straight end segments **122** connected by curved segments **123**. In some embodiments, straight side segments **131** of the intermediate coils **120** have a length from 12-17 mm, such as about 15.5 mm; straight end segments **132** of the intermediate coils **120** have a length from 4-8 mm, such as about 6 mm. Also, lower coils **130** include straight side segments **131** and straight end segments **132** connected by curved segments **133**. In some embodiments, straight side segments **131** of lower coils **130** have a length from 11-15 mm, such as about 14 mm; straight end segments **132** of lower coils **130** have a length from 2-5 mm, such as about 4 mm. In accordance with some embodiments, a straight spring coil segment is defined as having a linear path of at least 1 mm, include at least 1.5 mm, at least 2 mm, or at least 3 mm. Curved segments **113**, **123**, **133** span an arc of about 90°±5°.

In other embodiments, some or all of the spring coils have an oval shape, an elliptical shape, or a "racetrack" shape (e.g., straight sides with semicircular ends). In some such embodiments, intermediate coils **120** have a rectangular coil shape and upper coils **110** have an oval shape that is sized to nest within the intermediate coils **120**. In some embodiments, the lower coils **130** can also have an oval shape that nests partially or completely within the intermediate coils **120**. For example, a front portion of each lower coil **130** can nest within intermediate coils **120** while a rear portion of lower coils **130** stacks with intermediate coils **120**. In yet other embodiments, all of the upper coils **110**, intermediate coils **120**, and lower coils **130** have an oval shape.

In the top view of FIG. **1**E, straight segment **104***a* can be nested within upper spring coils **110**, the entirety of which are also nested within intermediate coils **120**. Note that straight segment **104***a* need not nest in all embodiments and may protrude above the coil stack during use with a magazine. In the bottom view of FIG. **1**F, straight segment **142***b* can be nested within lower spring coils **130**, which are partially nested within the intermediate coils **120**. Note that straight segment **142***b* need not nest and may protrude below the coil stack in use, in some embodiments. In this example, the lower coils **130** nest at the front **150** of the spring **100**, but some or all of the lower coils **130** stack with the intermediate coils **120** at the rear **152** of the spring **100**. In other embodiments, the entirety of each lower coil **130** nests within the intermediate coils **120**.

FIG. **1**G illustrates a close-up, perspective view of top end portion **102** and bottom end portion **104** of spring **100**, in accordance with one embodiment. As discussed above, the top end portion **102** includes straight segments **104***a*, **104***b* connected by turn **106** spanning about 180°. Bottom end portion **104** has straight segments **142***a*, **142***b* connected by a turn **144** spanning about 180° between ends of the straight segments **142***a*, **142***b*.

FIG. **1**H illustrates a top view of a spring coil **103** having a rectangular coil shape, in accordance with an embodiment of the present disclosure. In this example, representative of an intermediate spring coil **120**, the spring coil **103** has straight side segments **103***a* and straight end segments **103***b* connected by curved segments **103***c* of about 90°. Each straight segment has a length of at least 1 mm. In some embodiments, the straight side segments have a length from 9-20 mm and the straight end segments have a length from 2-8 mm as appropriate for the geometry of the magazine tube and considering the desired coil pitch, wire diameter, and other physical and functional characteristics of the spring. Segments of the spring coil **103** follow a generally helical path to connect successive coils that define a magazine spring **100**.

Referring now to FIGS. **2**A-**2**E, various views illustrate a magazine spring **100** in a compressed condition, in accordance with an embodiment of the present disclosure. FIG. **2**A illustrates a top, rear, and side perspective view; FIG. **2**B illustrates a rear elevational view; FIG. **2**C illustrates a side elevational view; FIG. **2**D illustrates a cross-sectional side view; and FIG. **2**E illustrates a top, rear and side cross-sectional view.

In its fully compressed state, the spring **100** has a solid height H that is less than the product of the number of coils and the wire diameter. That is, the different sizes of spring coils along the height of the spring **100** allow for nesting of upper coils **110** and/or lower coils **130** within intermediate coils **120**. Note in this example that the solid height H at the front **150** of the spring **100** is less than the solid height H at the rear **152** of the spring **100**. This difference is due to the size and shape of the lower coils **130**, which allows some or all of the front **150** of lower coils **130** to nest within the intermediate coils **120** and at least some of the rear **152** of lower coils **130** to stack with intermediate coils **120**. Accordingly, in the compressed state, the rear **152** of spring **100** has a greater number of stacked coils and greater solid height H compared to the front **150** of the spring **100**, in some embodiments. In other embodiments, the lower coils **130** nest completely within the intermediate coils in both the front **150** and rear **152** of the spring **100**. In some embodiments, the maximum solid height H_{max} is less than 60% of the product of number of coils and wire diameter. In one example, such as the spring **100** shown in FIGS. **1**A-**1**C having 10.5 total coils, including 9.5 working coils, the maximum solid height H_{max} is 6 wire diameters at the rear **152** of the spring **100** and the minimum solid height H_{min} is 4 wire diameters at the front **150** of spring **100**.

In the perspective view of FIG. **2**A, straight segment **104***a* and upper coils **110** are nested within the intermediate coils **120**; the straight segment **142***b* can also be seen nested within lower coils **130**, the front part of which are nested within the intermediate coils **120**. In the rear view of FIG. **2**B, the lower coils **130** stack with intermediate coils **120**. In the side view of FIG. **2**C, the maximum solid height H_{max} at the rear **152** of the spring is dictated by the stack of lower coils **130** and intermediate coils **120**; the minimum solid height H_{min} at the front **150** of the spring is the height of the stacked intermediate coils **120**, which is four wire diameters in this example. Since the base plate **180** may not be oriented perpendicularly to the axis of the magazine tube, the spring **100** may not compress at the rear of the magazine to the same extent as it does at the front of the magazine. Thus, it is more desirable to reduce the solid height H at the front **150** of the spring **100** than at the rear **152** since the angled orientation of the magazine tube and base plate allows for a somewhat greater solid height H at the rear **152** of the spring **100**. Thus, in some embodiments, the spring **100** can benefit from the forces associated with an increased size of lower coils **130** that do not nest completely with intermediate coils **120**, compared to smaller lower coils **130** that can nest completely within the intermediate coils **120**. Accordingly, lower coils **130** nest partially within intermediate coils **120** in some embodiments.

FIGS. **2**D and **2**E illustrate sectional side and perspective views, respectively, of spring **100** in a compressed state. In these figures, ends of coils are shaded for ease of identifying the coils: straight segment **104***a* has a dark shading, upper coils **110** have a medium shading, intermediate coils **120** have white shading, and lower coils **130** have a dark shading. Straight segment **104***a* is shown as being nested within and aligned with the uppermost upper spring coil **110**, which is nested within the top intermediate coil **120***a*. The straight segment **142***b* is shown as being nested within and aligned with the bottom-most lower coil **130**, which is partially nested within the bottom intermediate coil **120***d*. At the front **150** of the spring **100**, lower coils **130** nest within one another and within bottom intermediate coil **120***d*. At the rear **152** of the spring **100**, lower coils **130** stack with intermediate coils **120**. Note that straight segment **104***a* may not nest completely and/or may not align with the top upper coil **110***a* in all cases, depending on the attachment with the follower. Similarly, straight segment **142***b* at the bottom end portion **104** may not nest completely and/or may not align with the bottom lower coil **130***b* in all cases, depending on the attachment with the spring plate **160**.

FIGS. **3**A-**3**D illustrate various views of spring **100** in a compressed or partially compressed state on a spring plate **160**, in accordance with an embodiment of the present disclosure. FIG. **3**A is a bottom, side, and front perspective view; FIG. **3**B is a front and side perspective view; FIG. **3**C is a top perspective view; and FIG. **3**D is a top view. The spring **100** is on the top surface **161***a* of the spring plate **160** between the rear end **162** and a retaining tab **164** on the front end **163**. The spring's bottom end portion **140** is around a top protrusion **166** extending up from the top surface of a plate body **161** of generally planar geometry. The top protrusion **166** includes catches **167** configured to overlap or capture straight segments **142***a*, **142***b* of the bottom end portion **140**. Here, the upper coils **110** are not completely nested within the intermediate coils **120**.

FIG. **4**A illustrates a top and front perspective view of spring plate **160**, and FIG. **4**B illustrates a top plan view of spring plate **160**, in accordance with an embodiment of the present disclosure. As mentioned above, spring plate **160** includes a plate body **161** of generally planar geometry and having a top protrusion **166** extending from its top surface **161***a*. The top protrusion **166** generally has an oval shape consistent with that of the bottom end portion **140** of the spring **100**. Other geometries are acceptable. The top protrusion **166** includes catches **167** on its sides that are configured to overlap wire of the bottom end portion **140** so that the bottom end portion **140** is between the catch **167** and the plate body **161**. The retaining tab **164** extends upward from a forward and right corner region of the plate body **161**. In this position, the retaining tab **164** is out of the way of the follower when the magazine is filled to capacity, as will be discussed in more detail below. A bottom protrusion **168** extends from the bottom surface **161***b* of the plate body **161** and has a generally cylindrical geometry. The bottom protrusion **168** is useful to engage a corresponding recess in the magazine base plate to maintain the position of the spring plate **160** on the base plate. As such, the bottom protrusion **168** also functions as a retaining device in conjunction with retaining tab **164** to maintain the magazine in an assembled condition.

FIG. **5**A shows a top, side, and rear perspective view, and FIG. **5**B shows a top plan view, of a base plate **180**, in accordance with an embodiment of the present disclosure. The base plate **180** has a base plate body **181** with a planar bottom surface **181***a* and a top surface **181***b*. The top surface **181***b* defines a recess **182** shaped and sized to receive a spring plate **160**, such as spring plate **160** shown in FIGS. **4**A-**4**B, so that the top surface **161***a* of the spring plate **160** is substantially flush with or below the top surface **181***b* of the base plate body **181**. Within the area of the recess **182**, the base plate body **181** defines an opening **184** that extends through the base plate body **181**, the opening **184** sized and shaped to receive the bottom protrusion **168** of the spring plate **160**.

A wall **186** protrudes up above the top surface **180***b* and extends along the sides and front of the base plate body **181**. The wall **186** has a contour that is configured to mate with the outside surface of the magazine tube when assembled. Typically, the inside surface **186***c* of the wall **186** contacts the magazine tube when assembled therewith, however, a gap between the tube and the inside surface **186***c* is permissible, although not preferred. The outside surface **186***d* of the wall **186** can be continuous with the outside surface of the base plate body **181**, but it does not necessarily have to be. In an assembled state, the bottom of the magazine tube is received within the bounds of the wall **186** and in contact with the top surface **181***b* of the base plate body **181**. In this example, lateral portions **186***a*, **186***b* of the wall **186** each includes a vertical protrusion **188**.

The wall **186** defines an undercut **189** along each lateral portion **186***a*, **186***b*, positioned between the top surface **181***b* of the base plate body **181** and the wall **186**, and extending forward from a rear end **180***a* of the base plate **180**. The undercut **189** is open at the rear end **180***a* to enable laterally-extending lips or flange at the bottom of the magazine tube to be slidably received in the undercut **189** as the base plate **180** is slid onto the end of the magazine tube.

FIG. **6**A illustrates a top, side, and rear perspective view of the magazine base plate **180** together with spring plate **160** received in the recess **182**. Note that the retaining tab **164** is spaced from the wall **186** such that a sidewall of the magazine tube can be received in the gap. Note also that the top surface **161***a* of the spring plate **160** is substantially flush with the top surface **181***b* of the base plate body **181**.

FIG. **6**B illustrates a rear perspective view of the base plate **180**, spring plate **160**, and spring **100**, where the spring **100** is in a compressed state, in accordance with an embodiment. Note in this example that a gap **187** exists between the wall **186** and the spring **100** to receive the magazine tube.

FIGS. **7**A-**7**C show various views of a follower **210**, in accordance with an embodiment of the present disclosure. FIG. **7**A is a top, side, and rear perspective view; FIG. **7**B is a bottom, front, and side perspective view; and FIG. **7**C is a rear view. The follower **210** has an arcuate top surface **210***a* that extends between a front end **210***a* and a rear end **210***b*. Sides of the follower **210** are cut away below the top surface **211** to accommodate coils of the spring **100** when the spring **100** is in a compressed condition, for example. A spring protrusion **212** extends downward from an underside of the follower and generally has an oval shape to engage the top end portion **102** of the spring **100**. In some embodiments, the spring protrusion **212** includes catches **214** that extend outward from sides of the spring protrusion **212**. The catches **214** aid in retaining the top end portion **102** of the spring **100** on the spring protrusion **212**. As best shown in FIG. **7**A, part of the front wall defines a cut away **215** to provide clearance for the retaining tab **164** on the spring plate **160**. The cut away **215** is located on one side of the follower **210** in this example, but can have other positions, such as being near the center of the front wall of the follower **210**, in some embodiments. As best shown in FIG. **7**C, the rear wall has a lower margin **217** that inclines from one side to another (e.g., left to right as viewed from behind). In use, the incline of the lower margin **217** facilitates the rear end **210***b* driving into the space between the spring **100** and the magazine tube **220** when loading the last one or two rounds of a full magazine; the inclined profile functions as a wedge to make it easer to force the rear end **210***b* into that space and therefore can make it easier to load the final round.

FIG. **8** illustrates a side view showing the left and bottom sides of a follower **210** and part of a spring **100** engaging the spring protrusion **212** of the follower **210**, in accordance with an embodiment of the present disclosure. The top end portion **102** is around the spring protrusion **212**. Catches **214** on opposite sides of the spring protrusion **212** help to capture straight segments **104***a*, **104***b* of the top end portion **102** to retain the follower **210** engaged with the top end portion **102**. The underside of the follower **210** is open and sides of the follower **210** beneath the top surface are cut away to receive part of the spring **100** when the spring **100** is in a compressed condition. For example, the front end **210***a* and rear end **210***b* of the follower **210** overlap the coil stack of the spring **100** when the spring **100** is fully compressed or near-fully compressed, such as shown in FIG. **14**.

FIG. **9** illustrates a perspective view showing top, rear, and right side of the base plate **180**, spring plate **160**, and lower part of the spring **100**. The spring **100** is on the spring plate **160** with the bottom end portion **140** around the top protrusion **166**.

FIG. **10** illustrates a side view of a magazine **200** in an assembled and empty condition, in accordance with an embodiment of the present disclosure. The magazine **200** is configured for a handgun and includes a magazine tube **220** (shown as transparent), follower **210**, spring **100**, base plate **180**, and spring plate **160**. In its empty condition, the spring **100** is slightly compressed so as to urge the follower **210** toward the feed lips **224** the open top end of the magazine **200**. The spring **100** also exerts a force on the spring plate **160** toward the base plate **180**. The spring **100** is retained in various amounts of compression between the spring plate **160** and the follower **210** while the magazine **200** is empty, and spring **100** becomes more and more compressed as ammunition **202** is installed and follower **210** moves down the tube **220**. At the bottom of the magazine tube **220**, a tube flange **222** flares laterally outward from each side and is received in the undercut **189** on each side of the base plate **180**. The spring plate **160** is recessed into the base plate **180** with the bottom protrusion **168** extending into the opening **184**. The retaining tab **164** on the spring plate **160** extends into the magazine tube **220** and blocks the base plate **180** from sliding off the tube **220**. When the user pushes the spring plate **160** into the tube **220** so that the bottom protrusion **168** disengages from the base plate **180**, the base plate **180** can be removed from the bottom of the tube **220**.

FIG. **11** illustrates a front and partial cross-sectional view of an upper portion of the magazine **200** of FIG. **10**, where the magazine tube is shown as a cross section. The top end portion **102** wraps around the spring protrusion **212**. A central magazine axis **201** extends vertically through the magazine **200**. Note that the spring protrusion **212** is slightly laterally offset from the central magazine axis **201**, which facilitates vertical stacking of the spring **100** coils without crumpling of the spring **100**. Part of one front corner of the follower **210** is cut away for clearance with intermediate coils of the spring **100** and with retaining tab **164** on the spring plate **160** when the magazine **200** is filled to capacity (or slightly beyond) and the front of the follower **210** makes contact or is close to making contact with the spring plate **160**.

FIG. **12** shows a front view of a lower portion of a magazine **200**, in accordance with an embodiment of the present disclosure. In this example, the tube flange **222** of the magazine tube **220** (shown in cross-section) can be seen occupying the undercuts **189** on each side of the base plate **180** (shown as transparent). The plate body **161** is recessed into the base plate **180** with the spring **100** extending around the top protrusion **166**. In the locked condition as shown, one or more obstructions exist between the bottom protrusion **168**, the plate body **161**, the base plate **180**, and the retaining tab **164** that prevent removal of the base plate **180** from the magazine tube **220**. Pushing the spring plate **160** up into the magazine tube **220** would eliminate the obstruction and allow the base plate **180** to slide forward off the bottom of the tube **220** along tube flange **222**.

FIG. **13** illustrates a side view of a magazine tube **220** with an ammunition cartridge **202** retained by the feed lips **224**, in accordance with an embodiment of the present disclosure. The magazine tube **220** has a height H measured along the front wall of the tube **220** from a front bottom margin to an imaginary intersection with the ammunition's central axis **202***a*. In one embodiment, height H is not greater than 120 mm, including not greater than 117 mm, not greater than 115 mm, not greater than 114 mm, not greater than 112 mm, in a range from 110 to 114 mm, in a range from 110 to 116 mm, in a range from 110 to 119 mm, in a range from 110 to 114 mm, in a range from 110 to 112 mm, in a range from 114 to 118 mm, in a range from 114 to 116 mm, in a range from 112 to 118 mm, and in a range from 112 to 120 mm. In some embodiments, the height H is from 110-120 mm. In another embodiment, height H is not greater than 122 mm, including not greater than 119 mm, not greater than 117 mm, not greater than 116 mm, not greater than 114 mm, or not greater than 112 mm; in a range from 110 to 122 mm, in a range from 110 to 118 mm, in a range from 114 to 120 mm, in a range from 112 to 122 mm, in a range from 114 to 118 mm, in a range from 114 to 117 mm, and other ranges between values from 110 to 122 mm. In some embodiments, the height H is from 114-120 mm. In some such embodiments, the magazine **200** has a capacity of 17 rounds of 9×19 mm ammunition (aka 9 mm Luger) when the magazine **200** includes the follower **210**, base plate **180**, spring plate **160**, and spring **100** as discussed above and shown, for example, in FIG. **10**. Further, in some such embodiments, the spring **100** has no more than 11 coils, including 9-11 coils, 10 coils, and 9 coils.

FIG. **14** illustrates a rear perspective view of a lower portion of a magazine **200** loaded to capacity with ammunition **202**, in accordance with an embodiment of the present disclosure. The magazine **200** includes a base plate **180**, spring plate **160**, spring **100**, follower **210**, and magazine tube **220**. In this example, the magazine tube **220** is illustrated as being transparent to better show the components within the magazine tube **220**. Also, while only four rounds of ammunition **202** are shown, the position of the spring **100** and follower **210** are representative of the magazine **200** being loaded to capacity (e.g., 17 rounds) and the spring **100** is fully compressed or near-fully compressed.

Ammunition **202** on top of the follower in an offset, double-stack arrangement. The follower **210** overlaps the spring **100** at the front and back, and the follower **210** is cut away on its sides to accommodate the coils of the spring **100**. The spring protrusion **212** on the underside of the follower **210** extends into the nested coils of the spring **100**. Note that a central axis **202***a* of the ammunition **202** is inclined downward with respect to the bottom surface **181***a* of the base plate **180**.

FIGS. **15A-15C** illustrate a magazine spring **100'** configured for use in a magazine for rifle ammunition, in accordance with an embodiment of the present disclosure. FIG. **15**A is a perspective view showing the spring **100'** in a free state. FIG. **15**B is an isometric view and FIG. **15**C is a side view showing the spring **100'** in a mostly compressed state. The spring **100'** extends along a central spring axis **101** from a bottom end portion **140** to a top end portion **102** and includes alternating sections of coils of a smaller size and soils of a larger size. The larger coils **110***a*, **120**, **130***b* of spring **100'** have a rectangular shape while the smaller coils **110***b*, **130***a* have a racetrack shape. When compressed fully to solid height, all or most of the smaller coils can nest within the coils of the larger size so that the coils of larger size stack upon each other.

The top end portion **102** that includes straight segments **104***a*, **104***b* and turn **106**. Straight segment **104***b* is part of one of the upper spring coils **110** which include larger upper coils **110***a* of a larger size and smaller upper coils **110***b* of a smaller size. Intermediate spring coils **120** of the larger size are below the smaller upper coils **110***b* and connect to lower spring coils **130**, which include larger lower coils **130***b* of the larger size and smaller lower coils **130***a* of the smaller size. The larger lower coils **130***b* connect to straight segments **142***a*, **142***b* that are part of the lower-most coil.

Some or all of the upper spring coils **110** can nest within the intermediate spring coils **120** when the spring **100** is compressed. In some embodiments, at least two complete coils of the upper spring coils **110** nest (or can nest) within the intermediate spring coils **120**. In some embodiments, at least three complete upper spring coils **110** can nest within the intermediate coils **120**. Similarly, some or all of the lower spring coils **130** can nest within the intermediate spring coils **120** when the spring **100** is compressed. In some embodiments, at least two complete coils of the lower spring coils **130** nest (or can nest) within intermediate coils **120**. In some embodiments, at least three coils of the lower spring coils **130** can nest within intermediate coils **120**.

In the side view of FIG. **15**C, the spring **100'** is shown in a mostly compressed state. Here, only two coils of the smaller upper coils **110***b* and smaller lower coils **130***a* are visible due to partial nesting of smaller coils. Upon further compression to the solid height, the smaller upper coils **110***b* and smaller lower coils **130***a* nest completely within the adjacent larger coils so that larger upper coils **110***a*, intermediate coils **120** and larger lower coils **130***b* stack vertically on top of each other.

Further Example Embodiments

The following examples pertain to further embodiments, from which numerous permutations and configurations will be apparent.

Example 1 is a spring for a firearm magazine, the spring comprising a top attachment leg; a plurality of upper coils below the top attachment leg; a plurality of intermediate coils below the upper coils; and a bottom attachment leg below the plurality of intermediate coils, wherein individual coils of the plurality of intermediate coils have a rectangular coil shape, and wherein the upper coils are sized and shaped to nest within the plurality of intermediate coils when the spring is fully compressed.

Example 2 includes the subject matter of Example 1, wherein the upper coils have an oval coil shape.

Example 3 includes the subject matter of Example 1, wherein the upper coils have a rectangular coil shape.

Example 4 includes the subject matter of any one of Examples 1-3, further comprising a plurality of lower coils between the plurality of intermediate coils and the bottom attachment leg.

Example 5 includes the subject matter of Example 4, wherein the lower coils have a rectangular coil shape.

Example 6 includes the subject matter of Example 4, wherein the upper coils and/or the lower coils have an oval shape.

Example 7 includes the subject matter of any one of Examples 4-6, wherein the lower coils are sized and shaped to nest at least partially within the plurality of intermediate coils when the spring is fully compressed.

Example 8 includes the subject matter of Example 7, wherein when the spring is fully compressed, the top attachment leg is sized and shaped to nest within the plurality of upper coils, and the bottom attachment leg is sized and shaped to nest within the plurality of lower coils.

Example 9 includes the subject matter of any one of Examples 1-8, wherein the spring has from 9 to 11 coils.

Example 10 includes the subject matter of any one of Examples 1-9, wherein the spring has a maximum solid height of not more than 6 wire diameters.

Example 11 includes the subject matter of any one of Examples 1-10, wherein a front portion of the spring has a solid height of not more than 4 wire diameters.

Example 12 includes the subject matter of any one of Examples 1-11, wherein the wire diameter is from 1.1 to 1.45 mm, preferably 1.2-1.3 mm.

Example 14 includes the subject matter of any one of Examples 1-12, wherein the spring is configured for the firearm magazine sized for handgun ammunition.

Example 15 includes the subject matter of any one of Examples 1-12, wherein the spring is configured for the firearm magazine sized for rifle ammunition.

Example 16 is a magazine parts kit comprising the spring of any one of Examples 1-12, a magazine base plate, a follower, and a spring plate configured to nest with the magazine base plate.

Example 17 includes the subject matter of Example 15, wherein the base plate has a base plate body with a top surface that defines a recess sized and shaped to receive the spring plate such that the spring plate is recessed into the base plate body.

Example 18 includes the subject matter of any one of Examples 16 or 17, wherein the follower is configured such that a front portion and a rear portion of the follower overlap the intermediate coils when the spring is fully compressed.

Example 19 includes the subject matter of any one of Examples 16-18, wherein one or both sides of the follower are cut away to accommodate the intermediate coils when the spring is fully compressed.

Example 20 includes the subject matter of any one of Examples 16-19, wherein a lower rear margin of the follower is inclined with respect to a horizontal.

Example 21 includes the subject matter of any one of Examples 16-20, wherein an underside of the follower defines a protrusion configured to engage the top end portion of the spring, wherein the protrusion is laterally offset from a center of the follower.

Example 22 is a handgun magazine comprising a magazine tube extending along a central axis from a bottom end to a top end having feed lips; a follower retained in the magazine tube; a base plate on the bottom end of the magazine tube; a spring plate with a plate body; and a spring retained within the magazine tube between the spring plate and the follower, the spring including a top attachment leg, a bottom attachment leg, a plurality of upper coils, and a plurality of intermediate coils below the plurality of upper coils, wherein when the spring is compressed, at least two of the plurality of upper coils nest within the plurality of intermediate coils. In other examples, at least three of the upper coils nest within the intermediate coils.

Example 23 includes the subject matter of Example 22, wherein individual coils of the plurality of intermediate coils have a rectangular coil shape.

Example 24 includes the subject matter of any one of Examples 22-23, where the base plate has a base plate body with a top surface that defines a recess sized and shaped to receive the plate body of the spring plate such that the plate body is recessed into the base plate body.

Example 25 includes the subject matter of any one of Examples 22-24, wherein a rear end of the spring plate is between the magazine tube and the base plate.

Example 26 includes the subject matter of any one of Examples 22-25, wherein a height of the magazine tube, measured along a front wall of the magazine tube from a front bottom margin to an imaginary line through a central axis of a cartridge retained by the feed lips, is not greater than 120 mm.

Example 27 includes the subject matter of Example 26, wherein the height is not greater than 118 mm.

Example 28 includes the subject matter of any one of Examples 22-27, wherein an underside of the follower defines a protrusion configured to engage the top attachment leg of the spring, wherein the protrusion is laterally offset from a center of the follower.

Example 29 includes the subject matter of any one of Examples 22-28, wherein the follower is configured such that a front end portion and a rear end portion of the follower overlap at least some of the plurality of intermediate coils when the spring is fully compressed.

Example 30 includes the subject matter of Example 29, wherein sides of the follower are cut away to accommodate the plurality of intermediate coils when the spring is fully compressed.

Example 31 includes the subject matter of any one of Examples 22-30, wherein a lower rear margin of the follower is inclined with respect to a horizontal.

Example 32 includes the subject matter of any one of Examples 22-31, wherein the magazine has a capacity of 17 cartridges of 9 mm Luger ammunition.

The foregoing description of example embodiments has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the present disclosure to the precise forms disclosed. Many modifications and variations are possible in light of this disclosure. It is intended that the scope of the present disclosure be limited not by this detailed description, but rather by the claims appended hereto. Future-filed applications claiming priority to this application may claim the disclosed subject matter in a different manner and generally may include any set of one or more limitations as variously disclosed or otherwise demonstrated herein.

What is claimed is:

1. A spring for a firearm magazine, comprising:

a top attachment leg;

a plurality of upper coils connected to the top attachment leg;

a plurality of intermediate coils below the upper coils;

a bottom attachment leg below the plurality of intermediate coils; and

a plurality of lower coils between the plurality of intermediate coils and the bottom attachment leg;

wherein individual coils of the plurality of intermediate coils have a rectangular coil shape; and

wherein at least two of the plurality of upper coils nest within the plurality of intermediate coils when the spring is fully compressed; and

wherein the top attachment leg nests within the plurality of upper coils and the bottom attachment leg nests within the plurality of lower coils when the spring is fully compressed.

2. The spring of claim **1**, wherein the upper coils have an oval coil shape.

3. The spring of claim **1**, wherein the upper coils have a rectangular coil shape.

4. The spring of claim **1**, wherein the lower coils have a rectangular coil shape.

5. The spring of claim **1**, wherein the plurality of upper coils and/or the plurality of lower coils have an oval shape.

6. The spring of claim **1**, wherein the lower coils are sized and shaped to nest at least partially within the plurality of intermediate coils when the spring is fully compressed.

7. The spring of claim **1**, wherein the spring has from 9 to 11 coils.

8. The spring of claim **7**, wherein the spring has a maximum solid height of not more than 6 wire diameters.

9. The spring of claim **8**, wherein a front portion of the spring has a solid height of not more than 4 wire diameters.

10. The spring of claim **1**, wherein the wire diameter is from 1.2 mm to 1.4 mm.

11. A magazine parts kit comprising:

the spring of claim **1**;

a magazine base plate;

a follower; and

a spring plate configured to nest with the magazine base plate.

12. The magazine parts kit of claim **11**, wherein the magazine base plate has a base plate body with a top surface that defines a recess sized and shaped to receive the spring plate such that the spring plate is recessed into the base plate body.

13. The magazine parts kit of claim **11**, wherein the follower is configured such that a front portion and a rear portion of the follower overlap the intermediate coils when the spring is fully compressed.

14. The magazine parts kit of claim **13**, wherein one or both sides of the follower are cut away to accommodate the intermediate coils when the spring is fully compressed.

15. The magazine parts kit of claim **14**, wherein a lower rear margin of the follower is inclined with respect to a horizontal.

16. The magazine parts kit of claim **11**, wherein an underside of the follower defines a protrusion configured to engage the top end portion of the spring, wherein the protrusion is laterally offset from a center of the follower.

17. A handgun magazine comprising:

a magazine tube extending along a central axis from a bottom end to a top end having feed lips;

a follower retained in the magazine tube;

a base plate on the bottom end of the magazine tube;

a spring plate with a plate body; and

a spring retained within the magazine tube between the spring plate and the follower, the spring including a top attachment leg, a bottom attachment leg, a plurality of upper coils, a plurality of lower coils, and a plurality of intermediate coils below the plurality of upper coils,

wherein, when the spring is fully compressed, at least two upper coils nest within the plurality of intermediate coils, the top attachment leg nests within the plurality of upper coils, and the bottom attachment nests within the plurality of lower coils.

18. The handgun magazine of claim **17**, wherein individual coils of the plurality of intermediate coils have a rectangular coil shape.

19. The handgun magazine of claim **18**, wherein at least some of the lower coils nest within the plurality of intermediate coils when the spring is fully compressed.

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